Editorial

NOW that the elections have come and gone, we might expect to see some revival in the political problems of radio which appear to have gone to sleep during the last few months.

A change of Government could easily have meant considerable changes in the radio scene, but it now appears likely that matters will go on much the same as they would have done without an election.

Among the matters of which little has been heard lately is television. What transpires in this field will probably depend more and more on the international situation which, as was pointed out some time ago, is a vital factor in determining how much of our money and resources we can spare for it.

The news lately does not indicate any lessening of the tension in Korea. In fact the chances are that the next few months will decide whether we will be called upon to concentrate portion of our radio industry on materials for defence, and if so, how much this concentration will absorb effort which otherwise would have been available for television. Already the American radio trade has swung much of its output into war production.

Although there has been no further political statement or apparent movement on television, there has been steady preparation for it in various radio factories. Most of them have carried out experiments on a wide scale in receivers and transmitters. One factory we are told has a complete television set-up on a small scale in action with its output fed into co-axial lines to operate a number of receivers, and has a number of television chassis part assembled and wired. There are no doubt other factories in the same position. They will have gained thereby an opportunity to try out various assembly methods — a most important part of production.

At present, there seems no inclination to worry much about color. Not only is the progress of color overseas just as far from resolution as ever, but manufacturers themselves, realising the effect of a change in plans on their own efforts, appear quite happy to make a start on black and white. All are agreed that any systems contemplated must at all costs be compatible. No one wishes to see an alteration of standards in short order to accommodate color.

However, time alone can tell. That well worn adage was never more applicable than it is to television in Australia.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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Vol. 13 No. 3

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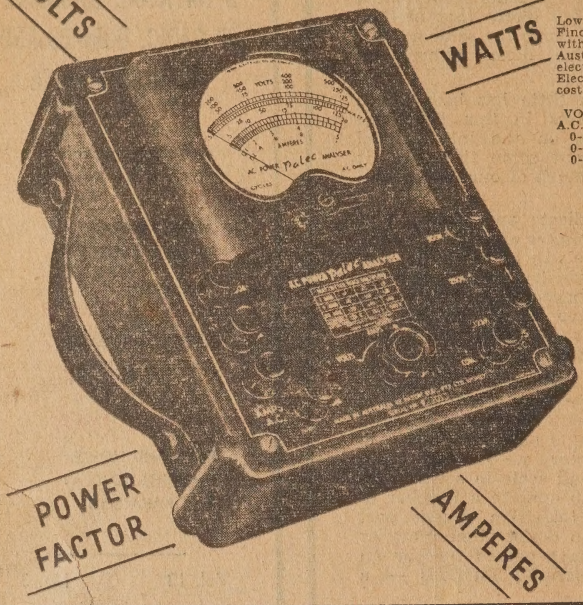
OUR COVER PICTURE

A fine shot of a Neptune long-range patrol bomber over the Golden Gate Bridge, San Francisco. The aircraft is basically the same as that recently ordered by the Australian Government.

Palec Power Analyser

reveals ELECTRICAL ENEMY No. 1

LOW POWER FACTOR



Low Power Factor is Electrical Enemy No. 1. Find and correct this costly electrical waste with the Palec A.C. Power Analyser, Model PA. Australia's first dynamometer multi-meter, for electrical service, maintenance and testing. Electricity efficiently utilised could save the cost of this instrument many times over.

VOLTS A.C.-D.C.	AMPERES A.C.	WATTS A.C.
0-125	0-1	0-10,000
0-250	0-5	9 ranges of watts
0-500	0-20	3 for each voltage range

ACCURACY: Effects of wave form, power factor, voltage, current and frequency variations are negligible.

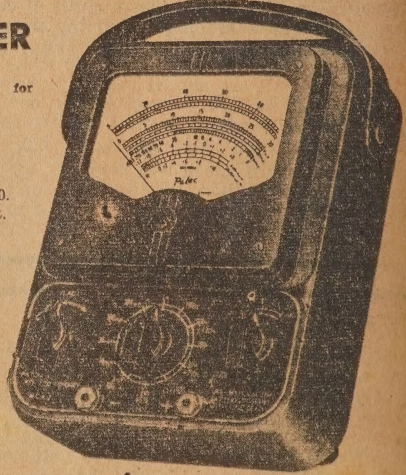
The Palec A.C. Power Analyser incorporates a true dynamometer movement of the nickel-iron cored type. There are no rectifiers or non-linear resistance included, nor is it necessary to compensate for line voltage in wattmeter readings.

APPLICATIONS: Industrial maintenance, production testing, laboratory work. Particularly suitable for testing and servicing refrigerators and other motorised appliances. D.C. as well as A.C. voltage may be measured.

EXTRAS: Leatherette-covered carrying case, external resistance box for 3-phase testing. Current and potential transformers for extending ranges supplied at extra charge.

DIMENSIONS: The Palec Power Analyser is housed in an exclusive semi-hard rubber case, size 8 inches by 9¼ inches by 4¼ inches overall. Weight, 8 lbs. Price on application.

Palec M.30 MULTIMETER



Model M.30—new 30-range multi-meter—is indispensable for modern radio and electrical technique.

Ranges—

D.C. Volts: 0-0.1, -3, -10, -30, -100, -300, -1,000.
A.C. Volts: 0-3, -10, -30, -100, -300, -1,000.
D.C. Milliamps: 0-0.3, -1, -3, -10, -30, -100, -300, -1,000.
Ohms: 0-10,000 and 0-1 megohm with internal Batt. 0-10 megohms with external Batt.
Decibels (a) Zero reference level = 6 milliwatts in 600 ohms: —17 to +3: +3 to +23: +23 to +43.
(b) Zero reference level = 1 milliwatt in 600 ohms: —10 to +10: +10 to +30: +30 to +50.

Other features: Meter scale, 4"; all measurements from two terminals only; bakelite housing; test leads supplied. Accuracy; reliability; low costs. Price on application.

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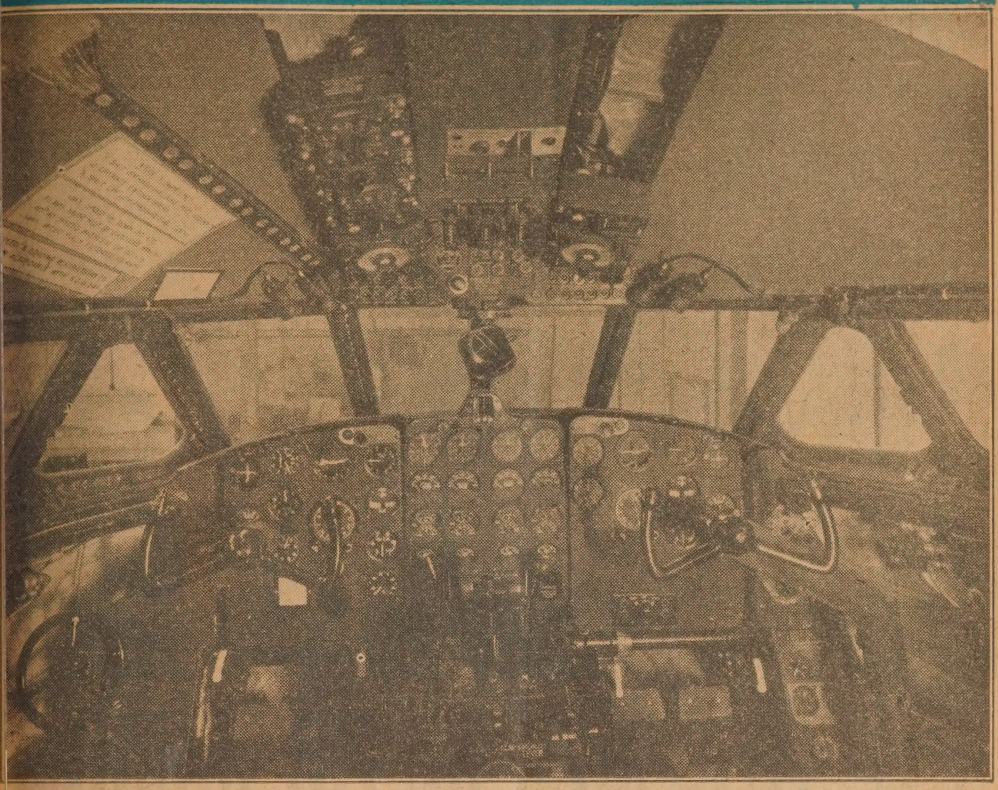
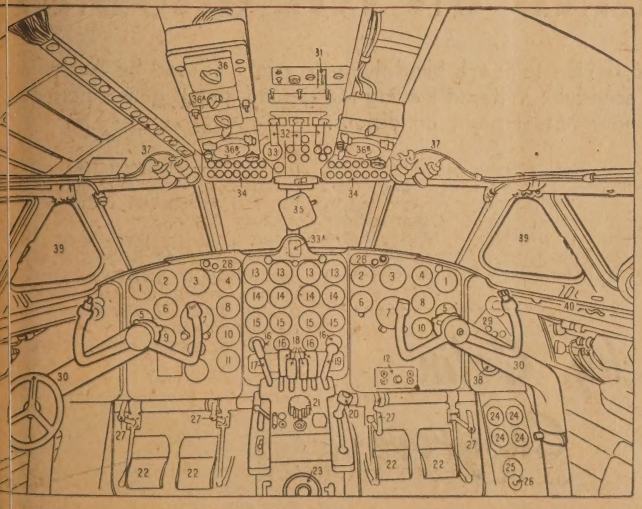
Manufacturers of all Types of Radio & Electrical Test Equipment & Meters.

90 ½ VICTORIA STREET, ASHFIELD, SYDNEY.
Tels.: UA 5268 (5 lines). Telegrams: "Palec."

CONTROLS SIMPLIFIED FOR COMET

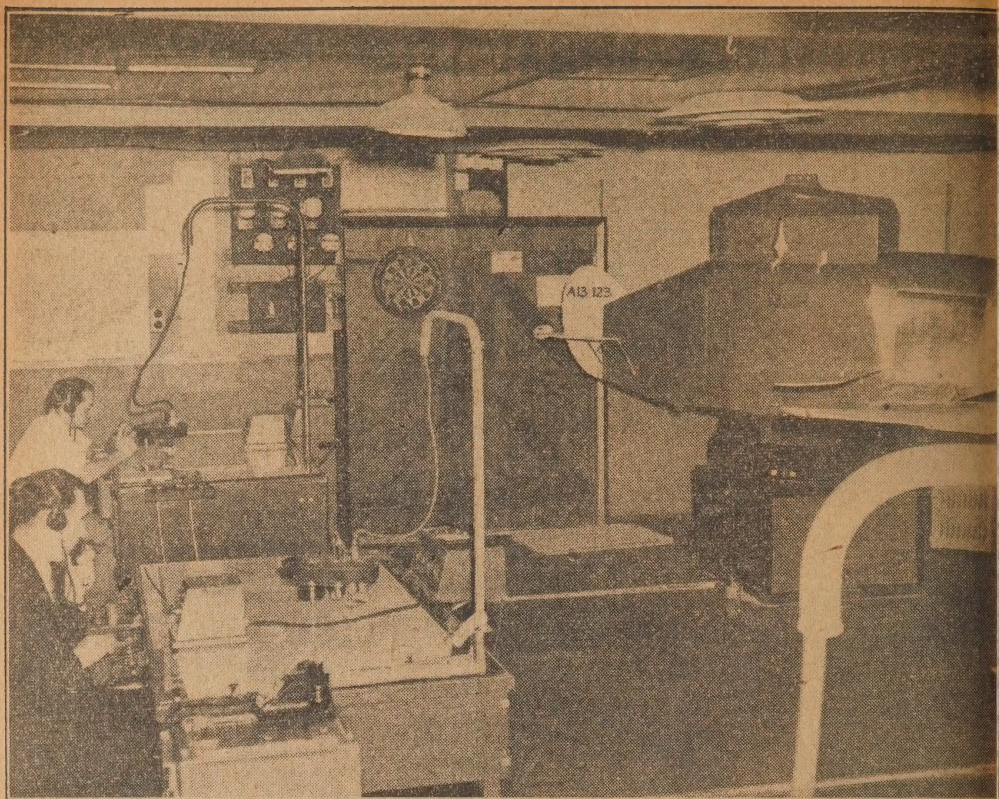


ritain's four-jet airliner, the de Havil nd Comet, is expected to be in service on BOAC's London-Cairo route toward the nd of this year. Compared with piston-engined aircraft the 32-seater Comets will mean lower running costs and easier main-enance. Comet passengers will find flying faster, smoother and almost noiseless, and the risk of fire will be smaller since the urbo-jet engines burn paraffin, which is less inflammable than petrol. Their crusing speed will be about 490 mph.



KEY MAP TO COMET CONTROLS

1-Instrument landing indicator. 2-Air-speed indicator. 3-Artificial horizon. 4-Rate of climb and descent. 5-Automatic direction finding indicator. 6-Altimeter. 7-Compass and directional gyro. 8-Turn and bank indicator. 9-Accelerameter. 10-Machmeter. 11-Outside air temperature. 12-Compass control panel. 13-RPM indicators. 14-Jet pipe temperatures. 15-Oil pressures and temperatures. 16-Rear bearing temperatures. 17-Brake parking lever. 18-Throttles. 19-Flap selector lever. 20-Air brake operating lever. 21-Automatic pilot control box. 22-Toe brake rudder pedals. 23-Rudder trim. 24-Hydraulic brake pressure gauges. 25 and 26-Oxygen regulator. 27-Rudder pedal adjustment. 28-Flying control booster warning light. 29-Hydraulic system low pressure warning lights. 30-Captain's control column and steering nose wheel control. Miscellaneous services. 31-Switch for secondary power control booster pump. 32-Power control boosters change-over levers. 33-Undercarriage warning light. 33a-Undercarriage mechanical indicator. 34-Fire warning light panels. 35-Magnetic compass and mirror. 36-ILS control box. 36a-VHF control box. 36b-Automatic direction-finding control box. 37-Instrument lights. 38-Hydraulic system pressure gauge. 39-Direct vision panels and 40-The hot-air pipe for demisting.



A general view of the training room. Instructors at the left operate instruments in the trainer cockpits and watch the course flow on the plotting table. One trainer is seen at the right—it is contro lled by the instructor at the rear.

SAFETY BEGINS ON THE GROUND

The Link trainer, famous wartime device to teach blind-flying to pilots, is used by Australian airlines as part of their training schedule. Without leaving the ground, pupils gain experience under actual flight conditions.

by Colin Cosgrove

VETERAN air travellers the world over are all too familiar with the disappointments and delays bad weather can cause. Flight schedule upsets mean not only missed business opportunities and holiday time wastage, but also present a very real prospect of losses to the airlines themselves. Of course, a percentage of such losses is budgeted for in laying down fares and other revenue scales, but a longish stretch of "airport closed" weather can become a heavy drain on profits.

It is not unnatural, therefore, to find all interested parties pressing ahead in the search for an absolutely safe means of navigating airliners from hangar to hangar through any weather.

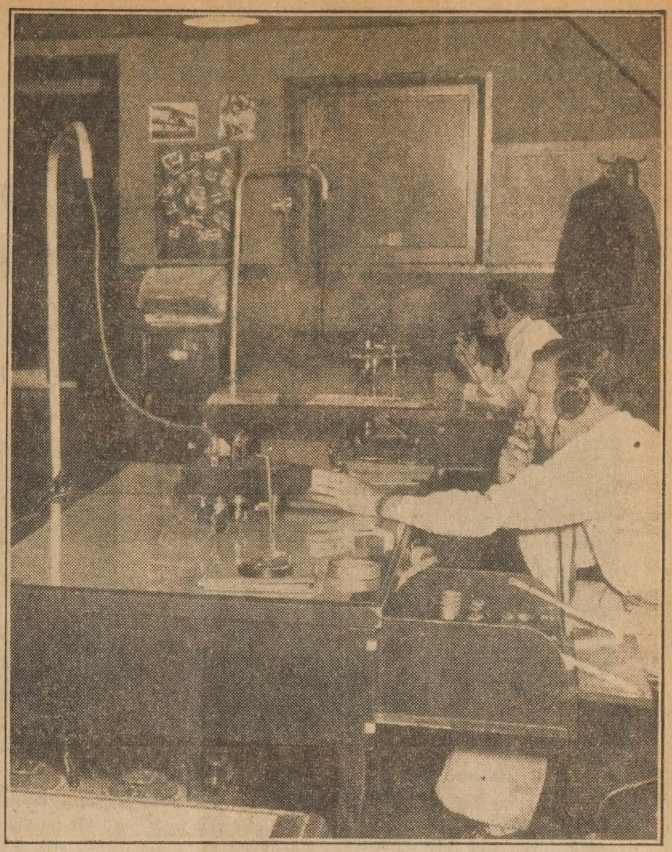
The search began in earnest back in the twenties, with the development of mail and passenger air services in the US and Europe. Great strides were made in Round II of the World War. Quite early in the conflict the Back Room Boys had developed a method for landing home-com bombers in darkness and fog v the aid of special radio gear runway lights.

But none of these methods, those developed since the close hostilities, is yet considered enough to warrant the entrustm of the lives of passengers in regular air services.

Instead, should cloud or fog c in to such an extent that a nor landing—by visual contact, as i called—is prevented, the airli concerned is usually diverted another airport.

Nevertheless, the development instrument approach techniques the refinement of radio aids h long since reached the point wh

Instructors Keith Knipe and Ray Blood shown in action. Microphone allows two-way communication with pilots "flying" in the trainers.



is quite common and safe for air-
ers to be brought down from
ising height in darkness or
rough the densest cloud to a posi-
n from which the pilot can com-
te a visual contact landing.

With the build-up of increasingly
mplicated assisted approach
thods, there has arisen the need
ickly and effectively to train pilots
their use. In the bad old days, this
s done in the air, the pupil-pilot
ing by instruments under a hood
some other means of confining his
ion to the cockpit. A safety pilot
instructor was carried, of course,
d this method is still widely used
testing pilots for their instru-
nt ratings.

This system was not only expen-
e and timewasting for training
rposes, but also had to be carried
t in reasonably good weather,
ich was by no means always
ailable when wanted.

These and similar problems, which
ew and became pressing with the
wth of airline flying generally,
l first to the invention and then
the increasingly rapid develop-
nt of the Link Trainer.

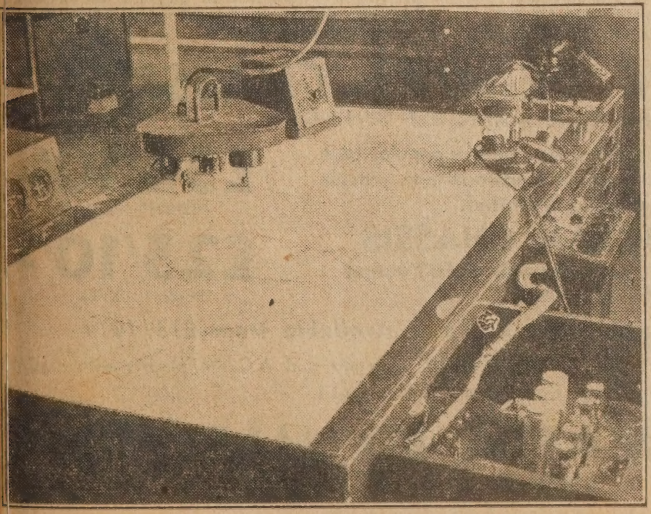
The Link Trainer as it stands to-
y is a device for the ground
ining of pilots in all phases of
trument flight and radio orient-
on. It consists of a dummy aero-
ne complete with wings and tail
faces, the normal control sur-
es, a full-sized cockpit equipped
h the standard instrument panel
d requisite radio gear, and the
ndard basic controls of control
umn, rudder pedals and throttle.
is fitted with a light-tight hood
ich can be raised or lowered at
ll. The whole is mounted on a
iversal joint above a substantial
se.

The trainer can simulate any manoeuvre met with in normal instrument flight, including an indefinite number of turns in either direction.

There is also a desk for the instructor equipped with two-way voice, morse and radio signal communication, a set of repeater instruments and a flight recorder which uncannily traces on a map or chart the courses flown by the pupil-pilot. Exercises from the most rudimentary instrument flight manoeuvres to the most complex cross-country, assisted apprpach and instrument let-down problems can be practised.

A moment's thought will suffice to enable an appreciation of the extreme value of this. Not only can pilot training be carried out regardless of the weather outside the trainer room, but a pilot may be instructed in, and repeatedly practise, the bad-weather approach system of an airport he has never before visited.

It all began with a man named Edwin A. Link who, at first alone and later in company with his brother George, built up a million-dollar trainer manufacturing business with well over a thousand employees in the head office and factory at Binghampton, New York



On this plotting table, an ingenious flight recorder traces accurately the course "flown" by the pilot under the hood of the trainer. Pilot corrects for conditions artificially produced by instructor and shown on trainer instruments.

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8 VALVE WORLD RANGE RADIOGRAM CHASSIS

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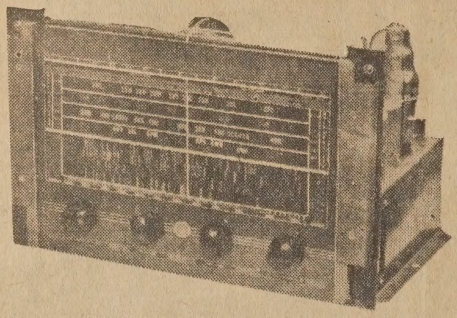
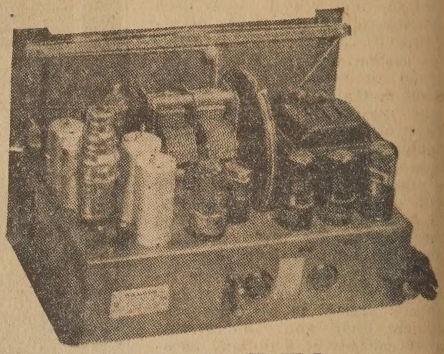




COMPARE THESE FEATURES

- Ultra modern circuit with permatuned iron cored coils and intermediates giving good interstate reception and a short wave range of 12,000 miles.
- High gain audio with push-pull output and tone control gives you high fidelity reproduction from both radio and your favorite recordings.
- Power switch is fitted to the tone control of all chassis thus enabling the power to be completely switched off from the set. Radiogram switch combined with wave change switch.
- All chassis are wired for the fitting of an F.M. or television tuner, special plug on back of chassis being provided.
- Speakers supplied are Magnavox 12" and 8" permanent magnet with tropic proof transformer. Single 12" supplied with 6 valve chassis.
- Large calibrated edge lit dial in plate glass (11" x 7") with main stations in each State in prominent type, fitted with counterweight drive and supplied with polished escutcheon. Indicator lights on dial showing which band in operation.

9 VALVE DE-LUXE CHASSIS

INCLUDING MAGIC EYE TUNING

With special switching facilities (with relay) for the popular tape or wire recorders. Also heavy duty power transformer to provide H.T. current for recording amplifier.

£34/10/- FREIGHT EXTRA

6-VALVE RADIOGRAM CHASSIS

Specifications as eight valve unit, but with single 6V6GT output valve and single 12" speaker.

£25/10/- FREIGHT EXTRA

Large Variety of Combination Cabinets Available from £13/10/-

RECORD CHANGERS AND PLAYERS. Collaro type 500 changers and A.C.504 players with crystal pick-up available for above chassis.

245 PARRAMATTA RD., HABERFIELD

PHONE UA2145

State, and many subsidiary plants in ther parts of the world.

Link's contribution to the Allied ictory, through making possible the apid and effective training of bomb- r pilots in the recent war though rossly under-publicised, was an im- nensely valuable and very real one.

In common with progressive air- ines the world over, Qantas Empire Airways maintains a modern, fully- quipped Link Trainer School. Situ- ted at Kingsford-Smith Airport, Mascot, NSW, the Qantas school andles the instrument flight train- ng of not only their own pilots ut also that of BCPA, Sydney- ased TAA and Police Flight Squad ilots. To date, well over 15,000 ours of instruction have been given, pproximately two-thirds of it to Qantas pilots.

The school is in charge of Leon . Deards, a softly-spoken, confi- ence-inspiring character of 35 who as been in aviation since he learned fly with the Clancy brothers in 936. There are three other instruc- rs on the staff: Sid W. McGowan, ay ("Cappy") Blood and Keith A. Snipe. All are ex-RAAF with many housands of hours instruction train- ng wartime bomber and fighter ilots in instrument flight. Exten- ve developments and modifications ave been carried out on the school's hree Links by Harold Stringer, hile daily maintenance is in the ands of Harold Marlin, both of hom are also ex-RAAF.

The instructors each average about hours a week which, coupled with he necessity of keeping a jump head of the pilots in new develop- ents, is quite enough when the eculiarly intense nature of the work considered.

ATEST MODIFICATIONS

Qantas' three Links were progres- vely acquired as the school ex- anded from the RAAF and RAAF sposals. All three machines have en extensively altered to incor- orate the very latest instrument t-down aids and procedures.

Details have recently been released a super-Link. Much larger and ore complicated, lacking the now nnecessary wings and tail of the der models but incorporating many finements and new devices, the ew model at first sight looks like pilot's nightmare. Certainly, the structor, while keeping him busy ith an intricate flight problem, can multaneously harass the poor pupil ith every possible difficulty, such engine failure or fire, that may er be met on route flying.

But these facts alone will ensure e more rapid and thorough mastery pilots of instrument flight ap- oach, control and let-down pro- dures, with a consequent widening the safety margin for both them- lves and their passengers.

Known as the F45 type when anufactured by Link Aviation De- ces Inc. in USA, the new machine also being made under licence at lesbury in England by Air Train- s Ltd., who call their slightly modi- d model the D4. Qantas may in- al a D4 in their Sydney school me time in the future.

Dr. FLYNN OF THE INLAND MISSION

DR. JOHN FLYNN.

When Dr. John Flynn DD, OBE, died in Sydney on May 5, the whole nation paid tribute to a man who banished the fear of sickness and isolation from thousands of men and women in the outback and inland spaces of Australia. In this we join, we who have watched his work from the beginning, in admiration of an epic of enterprise, courage, and devotion to a great cause. The Flying Doctor service to which Dr. Flynn gave his life will remain part of our history when its need has gone and is forgotten.

BORN 1880 in Victoria, Dr. Flynn's whole life was centred round the bush. At 18 he was a country school teacher, and four years later he joined the Presbyterian home mission staff. His decision to enter the ministry followed, and after his ordination in 1911, he went to South Australia.

This was the beginning of his experience of conditions in the far North, and he was soon appointed to make a study of this country, and report back to the Presbyterian Assembly.

His report, and activities which preceded it, marked him as a man of exceptional initiative, stamina and enterprise. So greatly did his work impress that he became Superintendent of the Australian Inland Mission. He held that post until October last year, retiring at the age of 70 years.

Dr. Flynn's early conviction was that the mission's work must be active, and not passive. He set out to extend the arms of the organisation so that help was in reach of everyone in the area.

The vast expanse of territory, the ruggedness of the country, and the essential need for speed in medical work, made the task a huge one. But there were two developments of civilisation which came to his aid—flying and radio.

NEED FOR SPEED

He saw clearly that for urgent cases transport must be available much faster than a bullock dray. He realised the value of radio in bringing calls for help with much greater speed than by a man on horseback.

The radio problem was solved by the co-operation of a young radio and electrical engineer, Herman Traeger. For while battery radio sets were available for receiving signals, the provision of a simply operated transmitter which needed higher power was the problem.

Traeger produced a transmitter-receive which obtained its power from a generator operated by a pedal system similar to that of a bicycle. While someone turned the pedals, another worked the set. By selecting suitable wavelengths, these pedal radios were able to span the required distances. They brought people into contact with their neighbors, and with suitably placed base stations where there were medical services.

This was a big step, but people still died because medical instructions via radio were inadequate in cases of serious illness and accident.

With Dr. K. St. Vincent Welch, the first "Flying Doctor," a system of air services was born which today is operated by six non-profit companies spread over every State in the Commonwealth, two of them being in Western Australia.

EPIC STORY

This unique service has produced a story of difficulties and courage unrivalled in any land. The early aircraft ran enormous risks during perilous flights over unchartered country, to land and take off under almost hopeless conditions, pressing their mercy errands in all weathers.

The highest of praise is due to the men who made these flights. Much of it must be shared by Dr. Flynn, his vision, and his persistance in the pursuit of his dreams.

"To those brave spirits who have gone out to open up that inhospitable country we call the Dead Heart," wrote Dr. Alan Vickers many years ago, "to those spirits, suddenly stricken by illness or crushed by accident, the drone of the aero engine as the doctor descends out of the clouds is like a saving voice from heaven."

It was to provide that saving voice that Dr. Flynn lived and died.

A DEVICE that will automatically turn off your radio when speaking interrups music was described to members of the Acoustical Society of America meeting in Cambridge, Mass.

Its most obvious use, said Dr. R. Clark Jones, of the Polaroid Corporation, who worked out the details of the device, would be by those music-lovers who dislike having music programs interrupted by commercials. Dr. Jones demonstrated how the small device works. It silenced the radio after one or two syllables of speech. The radio then remained silent until about one second after the speech had stopped.

Filling a long felt want—

Slade's Radio Pty. Ltd.

MODEL 508

makes available to Radio Dealers and Home Constructors a full range of Console Radiograms and Combinette Cabinets.

Made from best quality Maple and Italian Walnut veneers finished with a brilliant piano finish.

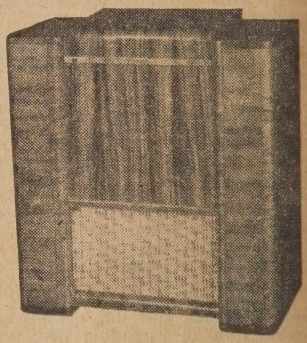
Model 508 is suitable for all types of Record Changers.

Model 509 is suitable for Single Motors. Dial fits on front of Cabinet, Lid being lifted only for record playing.

Model 509A is suitable for Record Changers.

Model 510 is a Combinette type Cabinet large enough to take a 5 Valve D/W Set with a Single Motor.

EXPERT PACKING FOR OUT OF TOWN DELIVERIES



Model 509

THE ABOVE CABINETS ARE ON DISPLAY AT UNITED RADIO, PHILLIP ST., SYDNEY

Let Slade's Radio or their Suburban Dealers show you how cheaply you can convert your old Radio Set into a modern Radiogram.

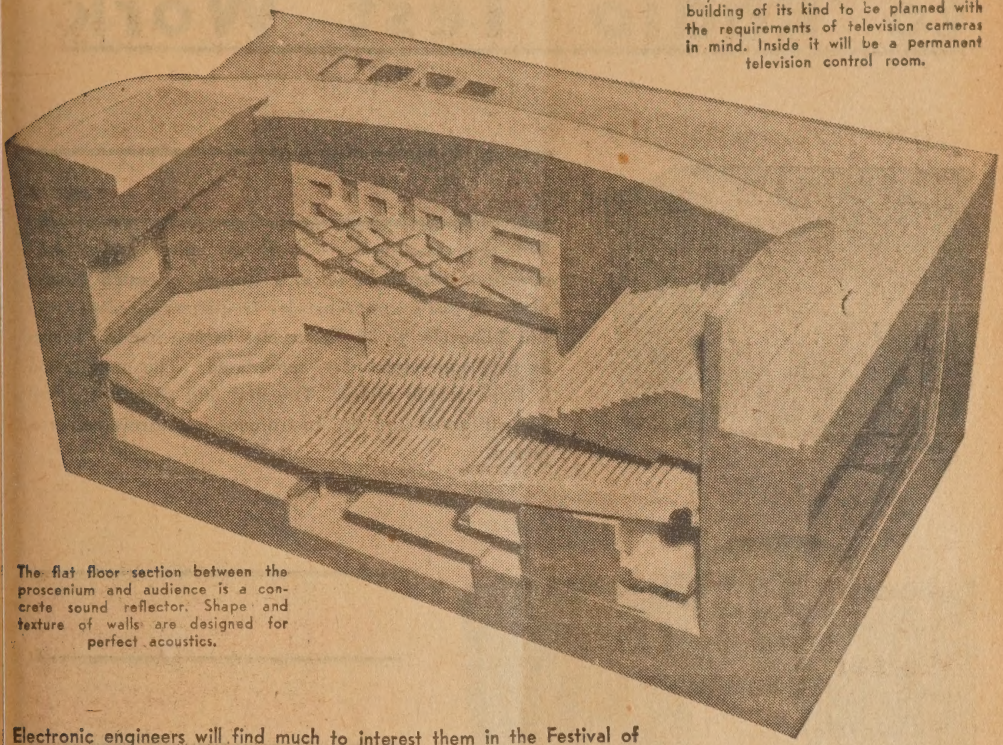
DAILY DEMONSTRATIONS OF FREQUENCY MODULATION AND MICROGROVE RECORDING AT OUR FACTORY

SLADE'S RADIO PTY. LTD.,

Lang Street, Croydon, N.S.W.—Tel. UJ5381-5382.

ESTABLISHED ——— 30 ——— YEARS

NEW "TELECINEMA" AT FESTIVAL



A model showing the interior of the Royal Festival Hall, the first major building of its kind to be planned with the requirements of television cameras in mind. Inside it will be a permanent television control room.

The flat floor section between the proscenium and audience is a concrete sound reflector. Shape and texture of walls are designed for perfect acoustics.

Electronic engineers will find much to interest them in the Festival of Britain, which will be held from May 3rd to September 30th of this year. Apart from the opportunity to visit radio, TV and other installations in Britain, they will be offered a comprehensive review of British industrial and research developments.

THIS exhibition, planned in the best contemporary style by a am of young architects and de-gners, sets out to display those pects of modern civilisation which ve most to British initiative. Each ilding will be devoted to one as-ct of life, for example agriculture, ansport, communications, the home, ort and so on.

One interesting building will be e "telecinema," a novel structure signed by the well known architect, ells Coats. Seating 400, it will monstrate all the most promising recent developments, including ll-size projected TV pictures, reoscopic films in color with channel sound on magnetic tape, high efficiency screen and special hting techniques. The purpose of stalling this complex equipment is conduct a full scale pilot experi-ent which, it is hoped, will reveal e possibilities of these new tech-ques of public entertainment. Dur-g the five months of the Festival the reactions of visitors will be noted, providing useful data for those in the cinema industry who are seriously concerned with its future prosperity.

RADAR

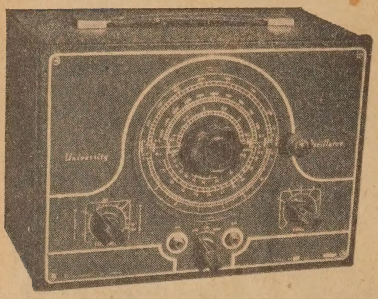
Experiment is also the keynote of the radio astronomy exhibits. There will be demonstrations of cosmic radio noise and meteor echoes and an attempt will be made to bounce high power pulses off the moon from a 120 magacycle transmitter with a remotely controlled aerial on the site. When conditions are favorable it may be possible for these echoes to be received in distant countries, such as the United States.

Radar equipment of a more orthodox kind will be demonstrated in the pavilion which deals with transport and communications. A 12ft (3.66 metres) scanner, radiating 0.1 micro-second pulses in the 3 centimetre band, will provide a brilliant picture on the Plan Position Indicator of a famous stretch of the Thames lying between the Houses of Parliament and St. Paul's Cathedral. Viewers will be able to track by radar the Festival river launches plying between the South Bank piers and the Festival Gardens in Battersea Park.

SAFER flying and better television pictures are promised with a new lamp developed in Bloomfield, NJ, by Westinghouse, that is said to be the brighest lamp now available for the current used. The value of the light for television is in projectors that televise motion pictures. This "short arc" lamp, which operates on 800 watts, produces a clear picture in black and white with excellent contrast and true grey shadings.

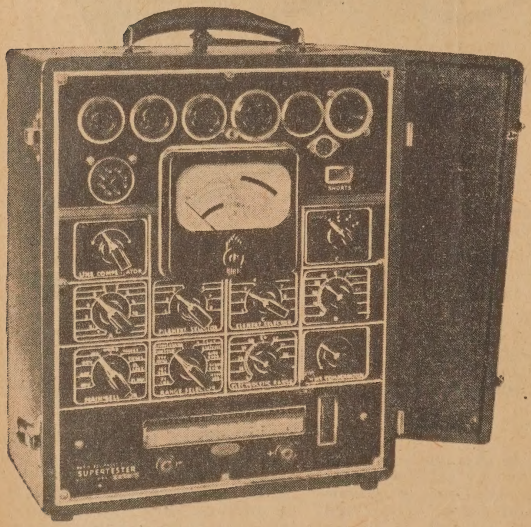
In aviation, the bright lamp is being used to shoot a narrow beam of light into the sky in order to measure cloud ceilings. The height of the cloud is recorded automatically by an instrument whose operation is based on the time required for the light to reach the cloud and return.

Bringing a NEW EFFICIENCY to Radio Test Work



Model XOA Oscillator

This fine Oscillator is available either as an A.C. operated Instrument or as a Battery operated Instrument. It has a comprehensive frequency coverage from 160 Kilocycles to 32 Megacycles in five bands. It can be used unmodulated or modulated. The modulation is 30 pc at 400 cycles. The dial and Output Control are calibrated and the Instrument is entirely self-contained.



Model TST Super Tester

Without a doubt the most efficient and up-to-date Valve and Circuit Tester in the Southern Hemisphere. The Model TST is a compact Instrument combining the functions of a Valve Tester, Multimeter, Output Meter, Paper and Mica Condenser Tester and Electrolytic Condenser Tester. An important feature is the time saving Roller Chart.

THEY'RE **University** INSTRUMENTS

MANUFACTURED BY

UNIVERSITY GRAHAM INSTRUMENTS PTY. LTD.

5 North York St., Sydney. 'Phone: BU3169 (2 lines)

DIAGNOSIS BY ELECTRONIC MD'S

Today we are very short of doctors. The story of the industrial revolution has been that where there is demand, scientists and engineers have always produced a supply. Will they now supply an automatic doctor to abolish the queues in doctors' waiting rooms and ensure equal treatment for all?

THE idea is not nearly so absurd as it may sound. There is already n "almost human" device which lips on to a car and finds out what wrong with it, more certain and ster than a skilled mechanic could o it.

The "near-human" machine, it is ue, is more complicated than a otor car but it is purely a matter f degree. You require a still more mplex piece of apparatus to ser- ice the electronic "vet."

There are already in use machines r recording heart beats, blood pres- re, "brain waves" and so on. The utomatic doctor would simply be collection of these devices neatly rought together.

HOTO-ELECTRIC CELLS

One part of the "doctor" would e delicate photo-electric cells apable of recording the patient's allor, the color of his tongue and on. Another part would meas- e his blood pressure, another his mperature, while another did a ood count. His heart beats would recorded and his brain examined an electro-encephalograph.

Possibly the machine would have typewriter keyboard, the keys rrying, instead of letters, a de- ription of symptoms—headache, ickache, nausea, pain after meals, ck of appetite, loss of weight, &c. The patient would be required to ress the keys that applied while swallowed a special meat which ould be x-rayed as it went down, ith photo-electric cells examining e x-rays.

All the information obtained by ese devices would be carried elec- ically to the "doctor's" brain—an ectronic calculating instrument. It ould have to be no more compli- ted than electrical calculators al- ady in use for computing artillery oles or solving problems in atomic ysics.

INAL CALCULATOR

The calculator would be set to ke into account all the symptoms d readings, and then give a diag- sis—gastric ulcers, influenza, ter on the brain, or whatever it ght be! Shooting out the appro- iate prescription and instructions a printed card would be simple to range.

I am most anxious you should not nk I am merely trying to be face- us. We have reached very near this stage already. During the r I attended an American hospital d I could not have had more kindly atment. But "mechanisation" was eady obvious.

I passed before a series of spec- ialists who each "assessed" me for his specialty and I was then check- ed for the whole by the "chief." Substitute the cardiographs, pyrom- eters and the other instruments for the specialists and the electronic calculator for the "chief" and you have the automatic doctor of the future.

Of course an automatic doctor would cost a huge sum but think how much it would save! It could work 24 hours a day and would need less than a minute a patient, since everything would be carried out at the speed of light—186,000 miles a second.

One automatic doctor could do the work of 50 of the merely human kind, thus releasing them for pro- ductive work in the mines or on railway stations where no doubt old- fashioned trade unionists will still be insisting on everything being done by hand in case machines caused unemployment.

NO ARGUMENT

There would be no arguing with the automatic doctor. If your symp- toms showed you were "swinging the lead," it would say so, and you would have to go back to work without argument. You could al- ways say the machine was out of order, but I doubt if the Ministry of Health would admit it—like the gas and electric companies with their meters, the Ministry would permit you to have the machine tested (by their experts) on condition you paid for the test!

It would probably be cheaper to admit you weren't really as ill as you felt.

This prospect of a machine meas- uring the number and distance apart of my spots, the color of my tongue and the condition of my brain and then shooting out a card saying, "A touch of flu, two days in bed with mixture 5, three times a day,"

by Professor A. M. Low

I find alarming. But it seems to me quite a logical development of State machine, and the idea of equal treatment for all.

There would be no nonsense about some people getting better treatment than others—the automatic doctor diagnosing and prescribing by the best Harley St. standards would be equally available in cities and re- mote villages.

There is a snag of course. "Every leaf of every tree is different," is the old saying. I think an electronic computor dealing with a few million variables would need a few billion more before it could diagnose and prescribe as well as an old-fashioned family doctor.

The old-fashioned family doctor had, perhaps, more brains than skill. But he is psychologically in a far higher category than the mere mem- ory man who knows every book on the subject, but lacks intuition, in- tellect or understanding—is, in fact, a mere machine. The family doctor knows that every human being is different and that what cures A may kill B or have no effect on C.

That is why the old family doctor does not fit into neat government pigeon-holes, or flourish on filling out forms in tripicate. He may not have the apparatus of a health centre, or the degrees of all the specialists at a hospital but he has humanity and great knowledge of a subject for which no degree is given—human nature.

The automatic doctor is to me a nightmare, but an inevitability if we continue on our present road. My one hope is that he will never go further than the experimental stage because he will be opposed by the strongest trade union in the world —the doctors.

* * *

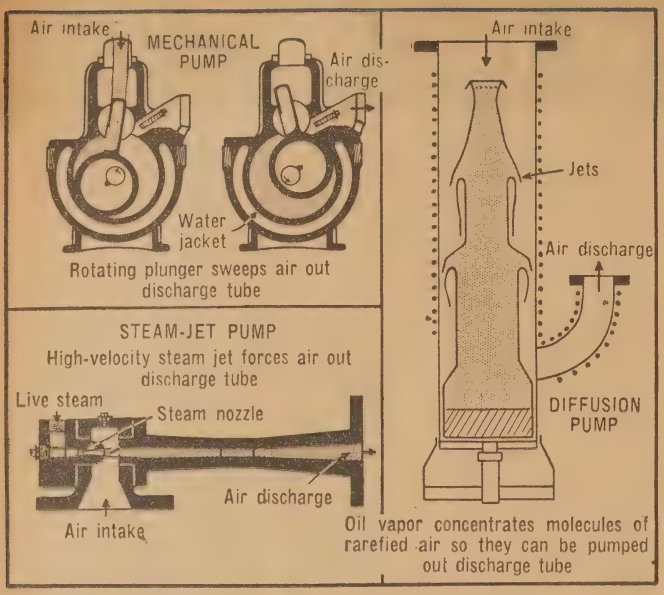
HARDNESS

I have often explained that hard- ness depends entirely on speed and that if you slap your hand on a basin of water it will sting because the water is hard at high speeds. You can assure yourself and your friends by demonstrating the hard- ness, as it were, of air at high speeds, or at least the pressure of air in the atmosphere against which a car has to push its way.

On a smooth table, hanging over one edge, place a thin board about 18in long by 10in wide. Open a newspaper and put two or three sheets over the half of the board which rests upon the table. You have positively "nailed" the board to the table and if you give the overhanging part a really hard blow with your fist you will find that nothing happens.

It is a matter of time, because the paper prevents the air getting under the board during the period of your blow. Press slowly with your little

(Continued on Page 93)



This diagram shows three differe types of pumps used to reduce a pressure. Each has its own use science and industry.

to have around the place. In a around the home it is one of th things which, although quite visible, performs useful service several ways.

If we think of a vacuum as space devoid of air, the most co mon example is the electric li globe. In New South Wales th will be remembered as those rou glass objects which used to li up when a switch on the wall w pressed. At the present time, ow to the shortage of power, th globes are more or less muse specimens and are not as relia for illumination purposes as modern kerosene lamps and cand

However, the air is exhaus from the light globe because, in presence of oxygen in the air, filament inside the globe would bu out in double quick time. Sometim I think that the globes I buy s have a lot of air in them.

Then there is the well-kno

HOW USEFUL IS NOTHING

Very useful, if we examine some examples to be found in industry and scientific research. Here we see vacuum processes being used extensively in new and vital processes. But as yet, no one has produced a perfectly empty space.

THE sole purpose of this article is to explain the methods used to obtain nothing.

There could be many definitions of the word nothing. Some would say that it is what one could buy with a pound note these days. Others would say that it is the amount of work one can get done for a pound note.

In a different category, NOTHING is what the doctor can do for a common cold. It is the exact amount in your pay envelope after you ask for a rise. It is what you get when you want potatoes or Australian cigarettes or bottled beer.

EXPENSIVE NOTHING

Yes. Today nothing is one of the most common "commodities" and, strangely enough, very expensive. Think of the taxes one pays to get nothing. Think of the "tips" one hands out to get no more than one should get without them.

All this is by the way. It really has nothing to do with the kind of "nothing" which is the subject of our discussion. However, I must take this opportunity to remark that "next to nothing" is what I get for writing this sort of stuff. I mention this merely as a passing thought for our editor to consider. (Duly noted.—Ed.)

What with the increased costs of living, the price of typewriter ribbons . . . . . Even the Post Office has spoilt the telegram forms they put on the counter.

SEARCH FOR VACUUM

At one time these were blank on the back and were ideal for typing on. Nowadays they print on the backs of them and I actually have to BUY paper. Even the once-blank "Stop Press" columns in the paper has something printed on them.

In such a world as we live in it is hard to believe that for many, many years some people have been striving to get "nothing."

They have been trying to get an empty space with nothing in it at all. They have been trying to obtain a perfect vacuum. By comparisons to the kind of nothing we all know this variety is most difficult to get.

A vacuum is a most useful article

noise producer—the vacuum clea In this affair a rapidly revol electric fan sucks the air away f the immediate vicinity of the no with the result that the surrou ing air rushes in to replace partial vacuum created, carr with it the dust and dirt, saf pins, nails, butchers' bills and c of wood knocked off the furni by the cleaner itself.

COMMON EXAMPLES

The vacuum flask used for k ing tea hot and beer cold is ano good example of the use o vacuum. These are ideal for pic because the largest available h about four cups of tea and about thirty shillings. If you all the relations out on Sunday need about six flasks and it s you at least a shilling that it w cost for a billycan of hot w By this saving you can pay off cost of the flasks over a perio about ten years. It is not ev where you can get such long t for time payment.

These flasks operate becaus their double glass walls, from

een which the air has been al-
ost exhausted. These walls are
ually silvered in order to reflect
wanted heat. They cannot be
ed as mirrors because, owing to
e curved surface, ones features
e frightfully distorted.

We would have no radio sets
ere it not for the valves in
em. These must be ex-
usted of air just as an
ectric light globe is, and for the
me reason. In addition to being
hausted by means of a vacuum
mp the residual oxygen is burnt
th from the space in the valve
d from the metal elements by
ectrically igniting some mag-
sium placed inside the valve be-
re it is sealed. This metal, con-
nses on the inside of the glass and
responsible for the silvered ap-
arance of the glass.

INDUSTRY

Here again the vacuum has ren-
ered a great service to mankind
y allowing us to observe the enor-
ous number of tooth pastes, pills,
olliticians, diet charts, motor oils,
izz masters, square-dance callers,
rivate detectives and supermen
hich we would otherwise not have
nown about. It also enables us to
now when we are going to have
power blackout, because the radio
oes off a few minutes before the
nnouncer has a chance to read out
ne districts which are going to be
lacked out. Progress—it's wonder-
l.

In industry today the demand for
igh vacuum is becoming greater.
ne interesting application is the
xtraction of vitamins and hormones
rom mixtures.

Vitamins, as everyone knows, are
ssential to the growth of the human
ody. They build bonny babies and
elp to ward off all the ailments
which flesh is heir.

Hormones are substances which
ave a great deal to do with growth
nd vitality. They make old men
oung, help to grow hair on bald
eads and restore lost vitality.

These vitamins and hormones are
adly affected by heat, so that great
are and control must be exercised
their extraction by heating.

It is possible now to extract these
ubstances by what is called "freeze
rying."

REEZE DRYING

In the normal process of evapora-
ion by means of boiling, the mole-
ules in the liquid, always in motion
ven in the cold state, are forced
ut against the downward pressure
f the incumbent atmosphere.

At normal atmospheric pressure
vater boils at a temperature of 212
egrees Fahrenheit.

If the number of air molecules
ressing down on the surface of the
iquid is reduced—in other words,
f the atmospheric pressure is lower-
d—it requires less heat to drive
he molecules of the liquid out
gainst this lower pressure.

That is why, at the top of very high mountains, water boils at a lower temperature.

Now, this reduction of atmospheric pressure can be brought about artificially by exhausting the air from a vessel in which the liquid to be evaporated is placed.

Under such conditions it is possible to lower the boiling point of water to below its normal freezing point. This sounds a bit funny, I know, but there it is.

Normally, when ice is heated, it turns first to water and then to steam. In a high vacuum, heated ice skips the water stage and turns directly into a vapor.

This business is called "cold boiling." The "boiling" water one sometimes gets at kiosks at picnic grounds must be "boiled" this way.

Penicillin will not stand heat, yet it does not keep well in solution. It must be kept perfectly dry. It obviously cannot be dryed by heating. Cold boiling solved the problem completely. By drying the drug in a high vacuum the necessity for high temperature did not arise.

COLD BOILING

This method is used to dry out such heat-sensitive substances as blood plasma, various types of medical serums and certain kinds of foodstuffs containing vitamins and hormones which are destroyed by heat.

Some foods, when dehydrated by heating, taste like dried gum-leaves or fried wattle bark. Some people do not like this. It can be avoided by drying in a vacuum. The food then looks and tastes like what it is, and retains its natural vitamin content.

The process is simple. Take the case of blood plasma. This is obtained from whole blood by spinning the blood in tubes in a machine called a centrifuge. The centrifugal force forces the heavy red blood corpuscles to the bottom of the tube, leaving the clear straw-colored plasma on the top.

This plasma is bottled, frozen and placed in a vacuum container, where the air pressure is gradually reduced. This causes evaporation of the water content of the plasma and a fine powder is all that remains in the bottles. These are then hermetically sealed and the plasma remains in a perfectly dry state.

This process can be carried out with any liquid, whether it be fruit juice or medicine.

There is a new process of metal coating of many articles, from paper to radio sets and clocks.

In a vacuum chamber metal such as zinc, silver, aluminium and even gold is heated and vaporised. It requires a lower temperature this way than heating in the open.

VACUUM PLATING

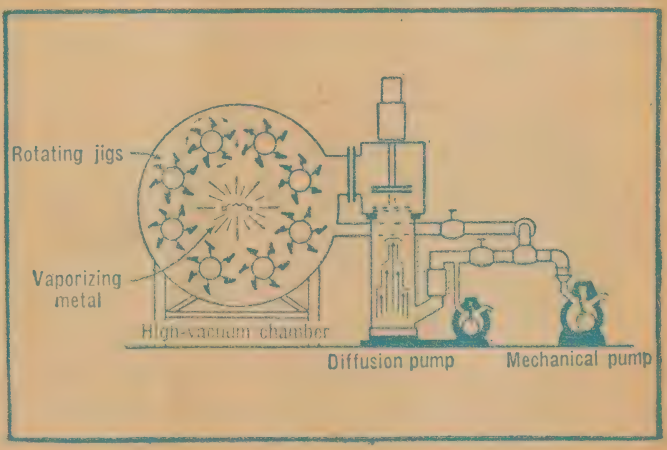
A roll of paper or perhaps cellophane or cloth is rapidly passed over this cloud of metal vapor which condenses on the surface of the material in a glistening film of metal. Radio sets, clocks and other articles to be coated are simply placed in racks inside a vacuum chamber filled with metallic vapor. Ribbons, buttons, jewellery (imitation) and many other articles are appearing on the market coated in this way. There may be possibilities here of coating pennies with silver to make them look like two-shilling pieces. In Sydney without any lights no one can see what you give 'em, anyway.

For the photographer a new method of reducing surface reflection makes use of a very thin film of magnesium fluoride over the lens.

This film is deposited by vacuum coating. Obviously, heat cannot be used because of the danger of cracking the glass. Lenses of telescopes, binoculars and miscroscopes are also treated in this way.

High-quality mirrors for reflecting

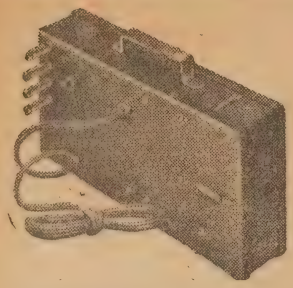
(Continued on Page 89.)



A frequent use of vacuum in industry is illustrated in this plating method which consists of vaporising metal at low air pressure.

WARBURTON FRANKI

Offer a complete range of components & accessories for the Radio Hobbyist



VAN RUYTEN PORTAPAC

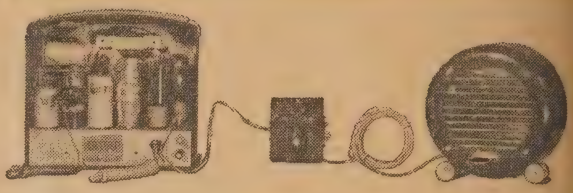
Enables you to use your portable radio from A.C. Mains **£10/5/-**

PRE-STOCKTAKING SPECIALS

Mantel cabinets -- -- -- **25/-** ea.
Personal portable cabinets **12/6** ea.
Voltage dividers 15,000 Ohm **1/6** ea.
Volume controls .1 meg .25 meg. -- -- -- -- -- -- -- -- **2/6** ea.
8" speaker grills -- -- -- **5/-** ea.

Carbon Resistors

1 watt, popular brand 200, 500, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 10K, 15K, 25K, 30K, 40K, 75K, 150K, 200K, 300K, 750K, 1 meg, 1-5 meg, 4 meg, 5 meg. **3/-** doz.

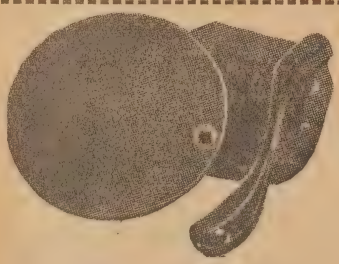


NEW AEGIS EXTENSION SPEAKER & ADAPTOR

Enables easy fitting of an extension speaker to any existing receiver. Speaker in walnut plastic cabinet **94/6;** speaker in cream plastic cabinet **97/6;** cabinet only, walnut **43/9;** cream **48/3;** adaptor unit **64/9.**

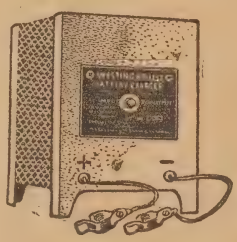
SPRING PORTABLE HANDLES

Neat and serviceable -- -- **3/6** ea.



New Plessey Record Player

In two models with magnetic pick-up -- -- -- -- **£8/15/-**
With crystal pick-up -- -- **£9/13/6**
Automatically plays 10" or 12" records on selection.



WESTINGHOUSE BATTERY CHARGERS

6 volt 5 amp -- **£7/10/-**
12 volt 3 amp -- **£8/12/6**

Leatherette-covered SPEAKER CABINETS

6" -- -- -- -- -- **32/6**
8" -- -- -- -- -- **36/6**
10" -- -- -- -- -- **44/9**
12" -- -- -- -- -- **51/8**

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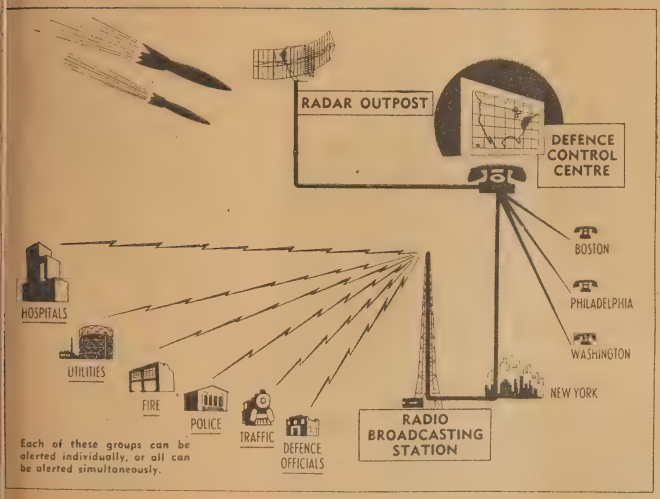
Trade also supplied ***Open Saturday Mornings***

Technical Review



This diagram shows how each defence group can be alerted individually or all groups in concert through the use of RCA alert receivers installed at strategic locations.

ALERT RECEIVER WARNS OF RAIDS

An ingenious and highly effective warning system for use in time of national emergency is announced by the American RCA Company. It consists of a small "alert" receiver responding only to a special warning signal which can be sent out through the normal broadcast stations.

THE Alert Receiver transforms existing radio broadcasting facilities into a warning system of great speed and wide scope. Through its use, entire communities, regions, or the nation itself can be alerted within the space of a few seconds.

The instrument, about the size of a portable radio set, turns on automatically when it receives a special inaudible signal from a broadcasting station, rings a bell, turns on a red or yellow light according to the kind of alert being sent out, and a white light when the all clear signal is flashed.

The receiver is simply constructed and its tubes require such negligible power that it can be operated 24 hours a day over long periods of time at low cost. It can use batteries or electric current.

The device may be fixed-tuned to any one broadcasting station. It is then receptive to the inaudible signal from that transmitter. A self-contained loudspeaker remains silent until the special signal is received.

When this signal arrives, it energises an electric relay which clicks the loudspeaker into the circuit to reproduce the transmissions from the broadcasting station.

Simultaneously, the bell rings. This is to insure the summoning of the listener in the event that the alert occurs at night. The bell, if desired, may be located at a distance from the receiver, so that the listener, although in a different part of the building, will not miss the call.

Lights on the instrument can carry the color signal denoting the type of alarm. For instance, colors that might be specified are: yellow, indicating preliminary warning of possible attack; red, indicating attack imminent, and white, announcing the all-clear.

At the transmitting station, the apparatus is very simple. It consists merely of a vacuum tube oscillator which generates the inaudible sound frequencies—one for each of the desired actions to be performed.

The signal generating unit is connected to the broadcast transmitter like a microphone. In fact the control room operator plugs the oscillator device into the microphone circuit. When a button is pressed it releases the "On" subaudible signal, which turns on all of the Alert Receivers equipped to be activated by it.

Engineers stress the fact that the Alert Receiver is as flexible as the highly developed transcontinental broadcast network systems, which permit the hook-up of two stations or hundreds by means of intricate switching arrangements already in service. Furthermore, the Alert does not require even one additional radio frequency allocation for its full use.

Civilian defence organisations usually have many different groups which must be warned. It is often desirable to warn some of these groups and not others. An outstanding feature of the receiver is that signalling can be made selective by groups in any way desired.

Alerting apparatus at the transmitter is compact and simple to operate.

THREE-SPEED HIGH FIDELITY RECORD PLAYER

Goldring

THE GOLDRING THREE-WAY PICKUP (No. 150)

HIGHEST FIDELITY REPRODUCTION.
Easy change from 78 rpm to 33 1/3 and 45 rpm by simply changing color coded stylus and moving weight adjustment.

OUTPUT
150 mV.

FREQUENCY RANGE
30—16,000cps

STYLUS PRESSURE
14 grms (78 rpm)
7 grms (33 1/3 rpm)

OPTIMUM LOAD
50,000 ohms

SAPPHIRE STYLI (supplied with PLAYER)

BLUE
0.003" for Standard Records

YELLOW
0.001" for 33 1/3 rpm Records.

REPLACEMENT STYLI
16/6 each

PLEASE NOTE: The unique design of this PICK-UP using stylus as ARMATURE does not permit use of other styli or needles.

MAIN FEATURES:

THE B.S.R. (BIRMINGHAM SOUND REPRODUCERS)

THREE-SPEED MOTOR M.U.14

- SPEED CHANGE by simply turning a knob.
- IDEAL FOR ALL TYPES OF RECORDS — standard or long playing (microgroove).
- The GOLDRING THREE-WAY PICKUP (No. 150) regarded by many experts as the greatest advance in pickup design.
- BEST QUALITY LEATHERETTE Covered Case can be closed when playing 12" records.
- Independent on-off switch.
- EASY PLUG-IN TO MAINS.

Motors by B.S.R. (Birmingham Sound Reproducers) enjoy a world-wide reputation for quality and reliability. Goldring are proud to incorporate the latest and most up-to-date B.S.R. MOTOR—THE THREE-SPEED MOTOR UNIT M.U.14 in this record player.

The ingenious and simple method of speed change is positive and smooth of action. It is achieved simply, by a movement of the speed change knob.

No belts of any type are used, a fact which greatly adds to reliability and eliminates the inherent 'wow' defects of the belt type of three-speed motor.

Smoothness of action is assured by employing the B.S.R. de luxe 4 pole motor which is noted for its low rumble and vibration factor.

Design of suitable pre-amplifier and equaliser supplied with each player.

PRICE: £21/10/- (Incl. 25% Sales Tax)
(Interstate slightly higher)

GOLDRING ENGINEERING (A/SIA) PTY. LTD., 57 H.E. AREA, ST. MARY'S, N.S.W.
Phone: St. Mary's 447. After Business Hours, UW6907

LATEST DEVELOPMENTS IN ULTRASONIC POWER

Latest developments in "Ultrasonics" are outlined in this extract from "Electronics" with special reference to the use of vibrating quartz crystals. Great promise is held for future applications in research, industry, and communications.

Phenomena associated with intense ultrasonic waves are no longer scientific curiosities and have been put to a variety of applications. Among recent patents is one for a washing machine using ultrasonic agitation to launder clothes.

Ultrasonic energy has been used to produce alloys of metals which are not ordinarily miscible. A new soldering iron uses ultrasonic vibrations to destroy refractory oxide film and permit soldering aluminium without flux. Sterilization of foods and coagulation of aerosols such as mist and smoke are subjects of ultrasonic investigation.

Waves generated by a circular piston source vibration at audible frequencies spread out from the source in all directions and will bend around corners. At higher frequencies the waves assume directional characteristics with more of the wave energy propagated in certain directions than others and with less bending. At very high frequencies the energy is concentrated in a cone whose angle becomes smaller as the ratio of wave-length to diameter of the piston source decreases. Such short waves are propagated essentially in a given direction with negligible bending.

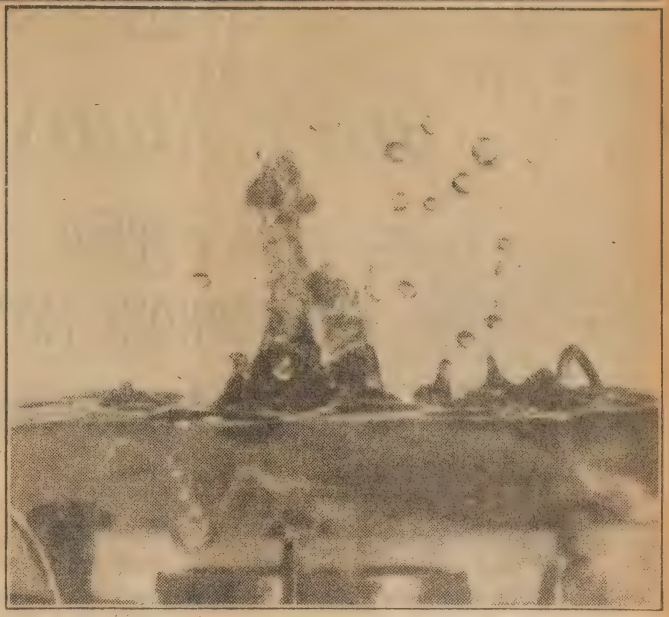
Concentration of ultrasonic energy into a cone makes it possible to produce beams of high intensity, defined as the energy passing through a unit area per unit time. Within the past few years ultrasonic sources have been built with outputs of 50 watts of acoustical power per square cm and beams of radiation have been focused to yield intensities of thousands of watts per square cm.

In the piezoelectric-type generator the high-frequency voltage output of a vacuum-tube oscillator is applied to electrodes on opposite faces of a properly cut crystal and produces periodic changes in the thickness of the crystal. When the oscillator is tuned to the natural resonant frequency of the crystal powerful mechanical vibrations result and a beam of ultrasonic waves is radiated through the medium surrounding the crystal.

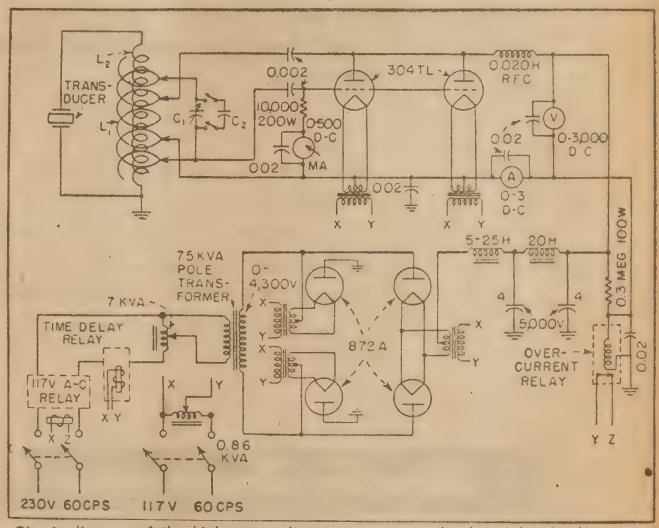
In the high-power ultrasonic generator now in use at the University of Missouri, Fig. 1, the input to the rectifiers is produced by a 7.5-kva pole transformer.

The output of this power supply, which can be continuously varied from 0 to 3000v, is applied to the two 304-TL tubes in parallel in the shunt-fed Hartley oscillator mounted in the grey panel rack.

The tank circuit capacitance provided by C1, a 0 to 400 pf variable air capacitor of 0.175in spacing, may be increased by a fixed mica capacitor, C2, when lower resonant frequencies are desired. Movable clips provide contact with coil tank, L1, and permit variation of tank inductance and grid excitation to obtain the desired frequency range and optimum efficiency. The resonant frequency of the tank circuit can be continuously varied from about 800 kc to 5 mc.



Vertical beam of ultrasonic energy radiated upwards through a liquid raises a mound of liquid several inches above the surface level and shoots droplets out to greater heights



Circuit diagram of the high-power ultrasonic generator developed by the University of Missouri. High tension is obtained from a .75 kva pole transformer feeding into a bridge rectifier circuit formed by four 872A's.

Since the amplitude of vibration of the crystal is proportional to the voltage applied to it, coil L2 is used as the secondary of a step-up transformer. No provision is made for tuning this secondary because a separate secondary coil is used with each crystal.

The secondary coil is mounted concentrically within the primary coil, each supported at its ends by

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teatite stand-off insulators equipped with corona shields. High voltage is conducted out of a large Pyrex seed-through insulator, and is applied to one face of the crystal transducer with the other face grounded. In this manner, as much as several kw of electrical power at many thousands of volts can be delivered to the crystal.

Of the many crystals available, quartz provides the most stable source of ultrasonic energy. The resonant frequency of an X-cut quartz crystal is determined by its thickness, a greater thickness corresponding to a lower frequency and a higher cost. Most of the manufacturers of standard radio crystals also provide ultrasonic quartzes ground to the desired frequency and plated with metal electrodes on both major surfaces.

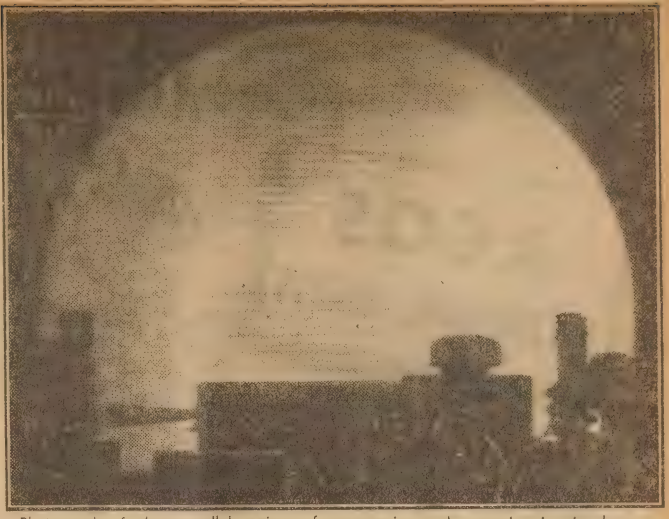
A one megacycle circular X-cut quartz of 1¼in diameter is adequate for most of the experiments to be described. For the optical experiments a 5 mc crystal is preferable and can be purchased at even lower cost.

A more advanced form of crystal holder shown in cross-section in Figure 2 is so designed that the useful ultrasonic output of the crystal is greatly enhanced. The quartz is mounted between two hollow brass cylinders which make electrical contact with the electrode platings on the crystal. The edges of the cylinders are rounded to reduce the large voltage gradients associated with the edges of the thin platings themselves. Higher voltages can be applied to the electrodes and the ultrasonic energy output proportional to the square of the voltage is increased. The useful energy output is also increased by the air backing for the crystal.

Little ultrasonic energy is radiated into air by the quartz as a consequence of the great difference in acoustic impedance (density x sound velocity) of the two media. Energy radiated upward into the dielectric liquid surrounding the holder and through the hole in the Plexiglas disk is thereby materially increased. A safety spark gap is employed to protect the crystal and the entire crystal holder is mounted on a brass plate.

If the crystal is excited at its resonant frequency and held in such a position that a vertical beam of ultrasonic energy is radiated upward through the liquid, the magnitude of energy in the beam can be visually demonstrated. At the liquid surface the ultrasonic beam raises a mound of liquid several inches above the level in the dish and droplets are shot out of the mound to far greater heights. Intensity of vibration in the liquid is so great that alternating pressure amplitudes as high as a thousand atmospheres and particle accelerations as high as a million times the acceleration of gravity can be achieved. This energy can be employed to produce a variety of interesting effects.

If the stem of a broken wine glass is held in the vibrating mound with the base of the glass upward and a fine powder such as lycopodium is sprinkled on the disc-like base, the

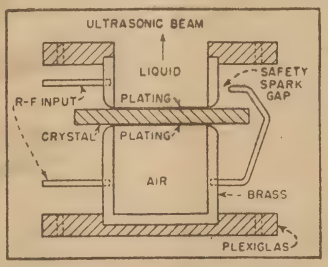


Photograph of plane-parallel regions of compression and expansion in air above a vibrating quartz crystal.

powder will form a beautiful system of concentric circular rings delineating the nodal lines in the pattern of vibration of the base. A similar effect can be obtained by merely dusting the inner surface of a champagne glass with the powder. The ring system will appear when the base of the glass is touched to the mound.

If the closed end of a glass tube about a foot long and half an inch in diameter and coated inside with a layer of heavy oil is deeped into the mound, the oil gathers itself into rings a millimeter or two apart, lining the tube from top to bottom.

A tapering glass rod, half a millimeter in diameter at the tip, with



Cross-sectional view of the improved crystal holder, showing design details and materials used.

its butt immersed in the mound, transmits vibrations of such intensity that the rod will burn its way rapidly through a chip of wood. Heating is the result of friction and occurs only at the point of contact. The remainder of the rod feels quite cool to the touch, but if it is squeezed, the frictional heating at points of contact with the fingers makes the rod feel too hot to hold.

For certain experiments it is necessary to conduct the ultrasonic energy from the mound into another liquid. A suitable container for the liquid can be made of a glass tube about an inch in diameter by cementing a thin disc of celluloid across one end to form the bottom of the container. If the base of this container is now held in the mound, its contents will be irradiated or "sonized" by the ultrasonic beam.

If water containing an ice cube is sonized for a minute or two and then the cube is squeezed between thumb and fingers, it will break into small fragments, showing that internal liquefaction has taken place throughout the mass, an effect similar to the production of "rotten ice" by exposure to the sun.

Effects somewhat similar to those described can be achieved with a low-power generator if steps are taken to focus the ultrasonic beam. The low-power electronic oscillator may be built, using the same circuit discussed previously with components of lower voltage and current ratings. An oscillator supplying the crystal with about twenty watts of r-f power at several hundred volts will give adequate performance. The ultrasonic beam can be focused with an ordinary watch glass. The concave surface of the watch glass, which may be about two inches in diameter, should be held in the beam so as to reflect the ultrasonic energy vertically upward toward the liquid surface. If the liquid level is adjusted to be exactly at the focus of the reflector, the liquid will be ejected from the surface in a thin stream rising high in the air and, at the same time, a dense fog will be produced.

If the beam is focused on the surface of a piece of rubber, or Plexiglas in the body of the liquid, the intense heating will produce small blisters on the surface and the material will have the characteristic odor of overheating when removed. In the same circumstances a block of wax will melt in such a way as to show the conical focusing of the beam inside the block.

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MIC. 3 DIAPHRAGM-ACTUATED crystal microphone, specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity.
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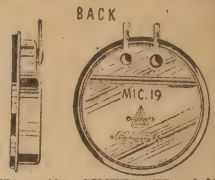

MIC. 19 SINTERCEL fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction.
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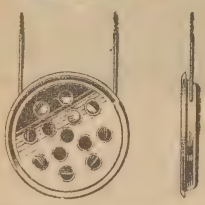

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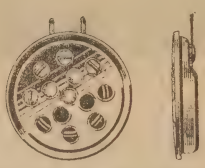

MIC. 14 STANDARD SPEECH MICROPHONE INSERT with nickel-plate brass case which gives high corrosion resistance, mechanical strength and rigidity.
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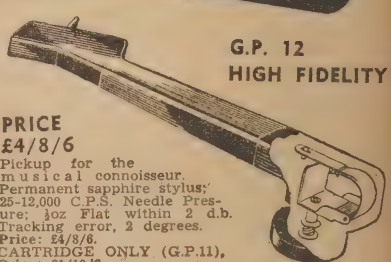

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SOLE AUSTRALIAN REPRESENTATIVES

NEWS AND VIEWS OF THE MONTH

Electronic Holmes

An electronic Sherlock Holmes is acques Bril, American investigator ho is also a keen electronic ngineer.

He can tell whether people are peaking the truth by lie detectors, ire a house with microphones while ou are looking, and identify a oman's perfume or the paint of a otor car.

His lie detectors do not register anges in blood pressure, but measre "animal electricity." Electrodes, rapped to the victim's palms, regter changes when he is telling a b. This was his first venture.

Now he has a motor car fitted ith a telephone which answers self if he isn't there.

It switches on a record to say that he owner is absent, but will you ave a message? A tape recorder hen comes into action and the call-r's remarks are taken down. When r. Bril returns, it's all waiting for im.

The same device is used by his peratives when working on a case. hey don't take notes—simply call he office where their spot-fresh impressions are recorded.

Posing as an electrical repair man r meter reader, he claims he can ire your house with a recorder uite without your knowledge.

He hides portable transmitters in all kinds of places, including a walking-stick. Strolling down the street talking to a suspect, he can broadcast conversations which are picked up by a car following him or parked up to half a mile away.

A new photo-electric spectrometer can take a speck of paint no bigger than a pin's head, and from it deduce the make and year of car from which it came. All such paint formulae are recorded, and the rest is easy.

★ ★ ★

TV future

VAST possibilities for television and associated arts were predicted recently in USA by Philo Farnsworth, pioneer television scientist.

TV telephones, he said, would be common 20 years from now, and would enable callers to see their friends as well as hear them.

He has little faith in large screen television tubes which are likely to end up as museum pieces. The tube of the future would be no larger than a cigar, and would project a large and brilliant image on a screen.

Perfectly feasible, he considers, is a TV tube about six inches long and one inch in diameter, with a projection screen brightness 15,000 times that of today's direct-viewing tube.

The image could be projected to a wall from a built-in screen in the receiver. The tubes would be of the "image amplified" type, costing less and lasting longer.

The pickup sensitivity of present-day TV cameras, he says, will before long become up to 100 times more powerful than today. They would be able to explore the infra-red region to which the human eye does not respond.

The ultimate tube would register images by their own radiation in total darkness. This view is also held by more than one Australian scientist.

★ ★ ★

Rainmaking Inc.!

DR. IRVING KRICK, chairman of the American Institute of Aerological Research, reported that successes of recent rainmaking tests had resulted in extension of cloud-seeding in 15 western States.

Hard-pressed drought areas of the West total more than 250,000,000 acres.

When tests first began in Washington State in June, 1950, only 100,000 acres were used.

Since then more than 30 farm and ranch organisations have joined in sponsoring projects aimed at con-

POPULAR SCIENCE QUIZ

Q. In books on astronomy we frequently encounter the term "light year." What does this mean, what has it to do with astronomy?

A. A "light year" is the distance which light will travel in one year at a velocity of 186,000 miles per second. To the average person this may sound fantastic when it is considered that there are 3600 seconds in an hour and 8760 hours in a year. The total number of miles which a ray of light will travel in one years is, therefore, the product of 186,000, 3600 and 8760, something approaching six million million.

Although it may seem incredible that measures of distance would need to go to such magnitude, the astronomer finds it desirable, or even necessary, to state the measurement of distance from the Earth to other heavenly bodies in something other than the familiar "mile" if he wishes to avoid the use of unwieldy figures.

As an illustration, consider the distance from the Earth of Proxima, the nearest visible star. To get to this star, you would need to travel about 25,000,000,000,000 miles, and, remember that this is the nearest one to Mother Earth. In using "light years" as the measurement of distance you can see that this huge mouthful of figures is avoided by simply stating that Proxima is about 4.3 light years away.

This form of measurement can be further appreciated when it is realised that the light which we see from the familiar North Star left that star about 200 years ago. "Coming down to earth," as it were, the rays of light from the sun take just over eight minutes to reach us. The sun is only 93,000,000 miles away.

Q. We know that knives and tool blades are treated in such a way as to give them their characteristic hardness or "temper." What is meant by "tempering?"

A. "Tempering" is a process whereby the molecular make-up of steel is "fixed" to any desired arrangement. In the first place, reduced iron ore, or pig iron, is treated by the Bessemer process wherein the carbon content is changed and other elements, such as manganese, chromium, nickel, &c., are added while the metal is in a liquid state. The result is what we know as steel.

The strength and hardness of cooled steel is governed by the arrangement of the molecules. Therefore, when the finished product is removed from the furnace, the cooling is controlled by immersions in cold water or certain oils. The sudden cooling "holds" the molecular structure of the steel at the stage where it exhibits the desired properties. This is the process known as "tempering."

Q. When places like Iceland, Newfoundland come into the news, we immediately think of wide expanses of snow, mountains of ice, glaciers. What are glaciers?

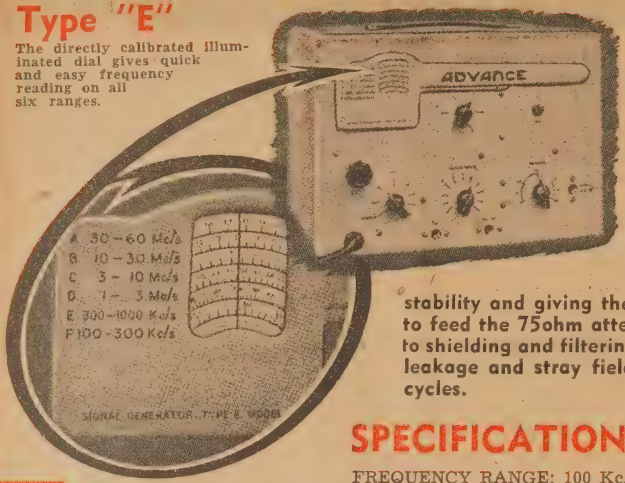
A. In mountainous country in the frigid zone, vast quantities of snow collect in valleys and gradually turn into huge masses of solid ice. When a mass of ice becomes so great that its hold on the sides and bottom of a valley fails, it grinds its way down the slopes to the sea, tearing up huge rocks and generally changing the appearance of that part of the earth's surface. It is this slow, grinding flow of ice which is called a "glacier."

Upon entering the ocean, the breaking up of the ice forms masses of varying sizes, called "icebergs," to become, in some cases, the all-too-familiar hazard to ships which navigate the waters fed by currents from the oceans in the polar regions.

"ADVANCE" SIGNAL GENERATOR

Type "E"

The directly calibrated illuminated dial gives quick and easy frequency reading on all six ranges.



The problem of poor attenuation, especially at frequencies above 10 Mc., has been overcome by the design of a properly shielded constant impedance 75 ohms ladder network whose output is taken to a matched transmission line. A Transitron R.F. Oscillator circuit is used, designed for high stability and giving the necessary constant output level to feed the 75ohm attenuator system. Careful attention to shielding and filtering of the power supply has reduced leakage and stray fields to 3 micro-volts at 60 megacycles.

SPECIFICATIONS

FREQUENCY RANGE: 100 Kc. to 60 Mc. in six ranges, calibration accuracy plus minus 1%. Using the second harmonic of Range A, the frequency range is extended from 60-120 Mc. Also on this range, British television sound and vision frequencies are marked. OUTPUT VOLTAGE is obtained from end of a 75 ohm matched transmission line. Output continuously variable from 1 microvolt to 100 millivolts. OUTPUT IMPEDANCE; When transmission line unterminated, 75 ohms, when terminated, three values obtainable: 37 ohms, 10 ohms, or 10 ohms through standard all-wave dummy aerial. 1-VOLT SOCKET: Steady output of approximately 1 volt is available at this socket. Output impedance is about 50 ohms. INTERNAL MODULATION: 30% at 400 c.p.s. approx. The output impedance is 50,000 ohms at maximum output. R.F. LEAKAGE: Oscillator section well shielded and external fields negligible (less than 3 microvolts). ACCESSORIES: 1 EF50 Valve (Mullard or Sylvania), 1 6J5G Valve, 1 6X5G Valve, 1 Pilot Lamp type M.E.S. 11 mm. 6.5 volt, 1 Termination Pad and Dummy Aerial, type T.P. 1, 1 Shielded A.F. lead, complete with Plug and Crocodile Clips, type P.L. 22. POWER SUPPLY: 110-210-230-250 volts 40-100 c.p.s. consumption approx. 15 watts. DIMENSIONS: 13" x 10½" x 7¾" deep overall. WEIGHT: 15 lbs. net. FINISH: Housed in attractive steel case, durable cream enamel, leather carrying handle.

"ADVANCE" AUDIO GENERATOR Type "F"

This instrument is a particularly flexible power source at audio frequencies for measurements on the frequency charcteristics of transformers, filters, transmission lines, and loudspeakers. Its attenuated ranges will also be found particularly useful. This instrument uses the harmonics of two radio frequency oscillators mixed together to give an audio frequency note of excellent wave form and free from effects of pulling. The instrument is entirely British made and is guaranteed for twelve months.

SPECIFICATIONS

FREQUENCY RANGE: 100 cycles to 10,000 cycles. ACCURACY: 2% plus minus 25 cycles. POWER OUTPUT: 1 watt, level to plus minus 6 db over full range. OUTPUT IMPEDANCES: 600 ohms, 5 ohms, or 10 ohm attenuator. DISTORTION: Total undesired signal is less than 3%, measured at 1000 cycles with matched 600 ohm load at 1 watt output. VOLTMETER: Range switched automatically with impedance switch. Two ranges: 0-40v., 0-4v. POWER SUPPLY: A.C. Power Supply 110-210-230-250v., 40-100 cycles. Power consumption is approximately 40 watts. VALVES: The following valves are supplied with the instrument—one ECH35, one 6J5, one 6X5, one EL33, one Indicator Lamp type M.E.S., 11 mm., 6.5v. LEADS. A complete set of leads is provided. DIMENSIONS: 13" x 10½" x 7¾" deep overall. WEIGHT: 16 lbs. net. FINISH: The instrument is housed in an attractive steel case, the panel and case being sprayed with durable cream enamel. A leather carrying handle is provided.

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rting parched western areas into urishing productive regions.

MOKE-SCREEN

CCORDING to available esti- mates, farmers in cloud-seed- g areas may expect their output increase by more than 1000-mil- n dollars (£446,428,571).

In the methods used by the Krick's oup and Water Resources Devel- ment Corporation of Colorado a bile smoke generator on the ound dispenses small silver iodide rticles into the atmosphere.

The particles enter a cloud and freezing temperatures ice crystals rm on them.

The crystals become snowflakes at fall into warmer air, where ey melt and become rain.

★ ★ ★

ack-seat driver

GENIUS who can never have had a mother-in-law has de- loped a back-seat driver that not ly tells you what you're doing rong at the wheel, but gives you report card at the end of the ive, says our New York corres- ndent.

It's the Roadometer, an educa- onal drive-tester that has been eeted with cheers by the insurance mpanies.

You can almost hear it chortle it takes you for a harrowing vo-minute ride, via colored movies.

You sit on a regular car seat, ith steering wheel, horn, signals, ccelerator and brake pedals all in roper position.

In front of you is the hood and movie screen. Behind you is a ightmarish collection of nuts, bolts, crews, wires, movie projectors, elec- rical relays and assorted mechani- al stuff.

A message flashes on the screen, elling you to drive normally and se all the equipment just as you ould in your own car. You push button marked "start" and you're ff.

The movie shows you the scene, s you drive down an innocent- ooking suburban street.

Before the next two minutes have lapsed, you're a nervous wreck— ou've been in a couple of smashes, it a pedestrian or two—and the Roadometer presents you with a core card showing just how poor driver you are.

If you happen to be a good driver nd don't hit anything the Roado- neter tells you you're good and your nsurance company loves you.

As you drive down the movie street irst a tough in a pick-up van cuts ou off. Then you have to steer round some construction work. Then big box falls off the truck ahead, ight where you can't miss it. Then ou have to steer around a sharp -curve.

All the time, as you accelerate, rake, blow your horn, use your ignals and steer, the Roadometer ehind you is clicking and banging. he clicks and bangs are evidence f an ingenious mechanical brain, which keeps track of how you are oing.

*Important NEWS

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Radio & Electrical Mechanics
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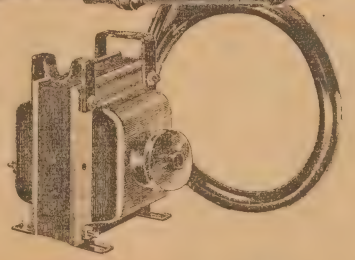
and all who use
a Soldering Iron

At last soldering has been looked at by scientific eyes. The object? To eliminate time wasted while the iron heats-up, consumption of current while the iron is not in use, danger of human or mechanical damage from parts of the iron not immediately connected with the soldering tip, and to provide safe, low voltage operation from A.C., D.C. or battery operation, or from A.C. mains with transformer.

The result is the now famous Scope Soldering Iron. It heats-up in six seconds, operates from 2.5/6.3 volts A.C./D.C. or from any mains supply with a suitable transformer. It consumes no current when not in use and operates instantly with a light thumb pressure on the switch ring. Beautifully balanced and almost feather-light, there is little chance of burning work or parts of the body as all heat is generated at the soldering tip.

Ask for a demonstration of this really remarkable soldering iron to-day at your local electrical dealer or supplier. Only a demonstration will convince you of Scope's extraordinary efficiency which is equal to that of *other irons rated up to 150 watts.*

SCOPE



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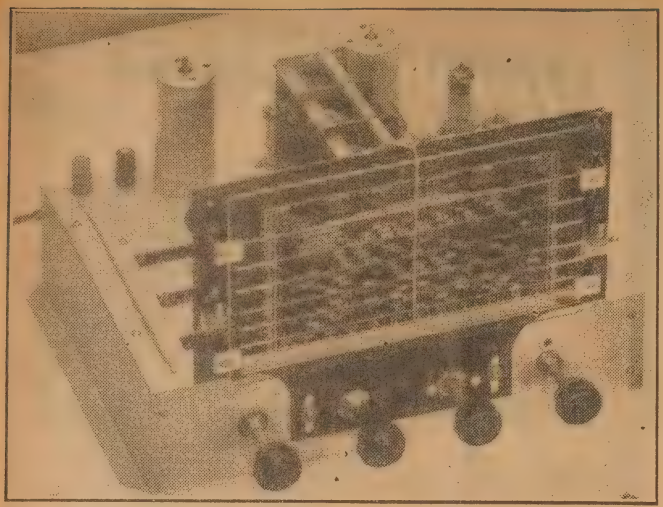


From the left controls are, Wave-change sw., Tone, Tuning, Volume and on/off sw.

A DUAL WAVE BATTERY FIVE

Here for the first time we are describing a dual-wave battery set using the miniature 1R5 converter valve. Built around a recently-marketed dual-wave coil bracket, this set will meet the needs of any ardent country listener. The inclusion of an RF stage ensures a performance which is matched only by the economical battery drain.

by Raymond Howe

RECENT descriptions of battery-operated sets such as the Pentagrid Four of the September, 1950, issue and the Pentagrid Five of the December, 1950, issue lend emphasis to the prevailing interest in dry battery operation. These sets were excellent performers in their own categories but, in the interest of simplicity, were limited to broadcast reception only.

When local atmospherics interfere with broadcast reception in the country, a good deal of entertainment can be drawn from the comparatively static-free short wave band. In addition to the program material available from overseas stations, Australian short wave stations relay many programs especially for the country listener.

A GOOD CHOICE

If you are in the market for a new battery-operated dual-wave set and you feel tempted to build one yourself, there is no need to look further. This set will do everything that you could expect from dual-wave reception in the country. The sensitivity on both the broadcast and short waves, together with the economy of operation, are the outstanding features. You need have no fears about the 1.4 volt miniature valves, either. They are in ready supply and have for the past few years been proving their dependability.

The basic design of this set, plus the comparative simplicity of wiring, has prompted us to include it in the Kit series. Accordingly, we have labelled it the Radio and Hobbies Kit No. 7.

There is a line-up of five valves —a 1T4 as an RF amplifier followed by the 1R5 converter, 1T4 IF amplifier, 1S5 second detector, AVC, and audio voltage amplifier to the 3V4 power output pentode.

The total B battery drain of the set at "no-signal" is 14½mA, falling to around 12½mA on signal. The filament drain is 300mA, about the same as that of a torch globe. The set will operate satisfactorily, even when the batteries are reaching the end of their useful life.

In the past, battery-operated sets posed special problems when it came to dual-wave operation. In contrast with AC type converter valves, with their higher oscillator trans conductance, the battery types wer struggling to maintain oscillation to wards the high frequency end o the short wave band.

With the IR5 some of the mai problems have been overcome an satisfactory operation is more o less assured if proper precaution are taken with the circuit design.

The main object is to keep th IR5 oscillating reliably and in stable fashion over the full rang of the short wave band. For thi reason, we will treat the converte stage in detail. All remaining por tions of the circuit follow more o less along conventional lines.

CONVERTER STAGE

The IR5 is a pentagrid converter so called because it contains fiv distinct grid structures apart fron the filament and anode. Grid No. is the oscillator grid and connects t pin 4. Grid No. 3 is the signal gri with pin 6 as the connection. Gri No. 5 is the usual suppressor an conects internally to the negativ side of the filament. Grids No. 2 an 4 are connected internally and ac as the oscillator anode as well a the conventional screen.

With this structural arrangement the signal grid is in between the tw grids forming the screen. Wher the screen is at a high RF potential the inter-electrode capacitance be tween the electrodes causes portio of the developed oscillator voltag to be fed back to the signal gri tending to produce "pulling" and los of gain on the short wave band. O the broadcast band, the effects ar not serious.

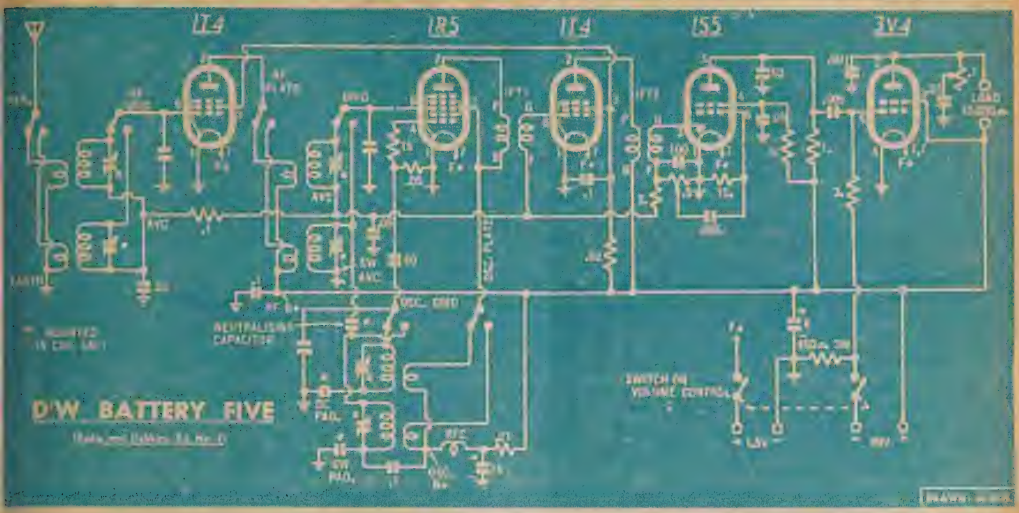
NEUTRALISATION

The problem on short-waves ca be overcome by a form of "neutral isation," whereby portion of the out of-phase voltage at the oscillato grid is deliberately fed through small capacitor to the signal grid If you glance at the circuit dia gram, you will see how this is done

As the corrective action is re quired on the short wave band only this small capacitor is wired i the coil bracket itself directly be tween the top ends of the converte grid and oscillator short wave coils

In the coil bracket used in th prototype set, we added the com ponent ourselves by drilling a smal hole in the partition towards th top left hand corner so that the smal

CIRCUIT DIAGRAM OF THE D/W BATTERY SET



The dual-wave switching, with the switch in the "broadcast" position, is shown for clarity of wiring to coil unit. Use an earth wire with the set to keep the chassis at RF "earth" potential.

apacitor could be wired between he appropriate contacts on the econd and third sections of the vave-change switch. All future nits marketed by the manufacturer ·ill carry this modification as stand-rd.

Various operating conditions for he 1R5 set the plate and screen oltage at 45 or 67½ volts or 90 volts or the plate and 67½ for the screen. he latter ratings naturally give the ighest conversion transconductance nd also the highest current drain.

MPORTANT POINT

We decided upon a common volt-ge source of about 50 volts for the late and screen as a compromise etween current drain and good onversion transconductance. An-ther point is that it avoids the eed for a dropping resistor and ypass in the feed to the screen. hese components are normally hot" to RF and are a nuisance for his reason.

The final and possibly the main oint in the operation of the 1R5 n the short-wave band is the time onstant of the oscillator grid capa-itor and grid resistor. For the roadcast band, the recommended alues for these components are 100 f. and .1 megohm. It seems desir-ble, however, to reduce these values o the figures shown in the circuit iagram to avoid a "squegging" ffect in the oscillator section, when perating on the short waves. The educed values have no appreciable ffect on the operation on the broad-ast band.

The 15 ohm resistor between the unction of the oscillator grid capa-itor and the grid resistor is in cir-uit as a further precautionary easure. It does not affect the normal operation of the set. The value is not critical and any figure up to around 50 ohms may be used.

You will see that we have shown the dual-wave switching in the RF and converter stages for the sake of clarity of the wiring to the coil unit. The points which represent tag and pigtail connections on the unit are labelled accordingly.

The RF valve grid circuit follows usual practice with the lower ends of the broadcast and short-wave coils returned to the AVC line through common decoupling components.

In the 1R5 grid circuit, you will notice that the AVC voltage is supplied to this valve when the wave-change switch is in the "broadcast" position only. It is desirable to remove the AVC voltage for short-wave operation. This is done simply by earthing the lower end of the short-wave grid coil for the 1R5.

In initial laboratory work, the manufacturers found it advantageous to apply a standing bias of minus three volts to the 1R5 signal grid for short-wave operation. On the coil unit, the lower end of the short-wave grid coil is brought out to a separate tag for this purpose and marked accordingly.

In our prototype model, we used slightly different operating conditions for the 1R5 for the reasons already mentioned and found that improved gain was had with zero bias on the 1R5 signal grid. There is room for experiment here, as the precise effect of the bias may vary in individual sets.

The well-known scheme of "padder feedback" is also desirable for shortwave operation, and for this reason you will see that the .1 mfd. bypass at the B-plus end of the oscillator feedback winding is returned to earth through the short-

PARTS LIST

- 1 Chassis 11½" x 8½" x 2½"
- 1 Miniature dual-wave coil bracket with RF stage and suitable for 1R5 (type 1R5 DWR6 16/50 or similar).
- 1 3-section tuning gang capacitor (Stromberg H or AWA)
- 1 Dial with glass to suit gang (USL32)
- 2 Standard IF transformers 455 kc, Nos. 1 and 2
- 5 Miniature 7-pin valve sockets, 1 miniature 4-pin plug and socket
- 2 45 volt heavy duty B batteries
- 1 1.5 volt heavy duty A battery
- 1 RF choke

VALVES

- 2 1T4, 1 1R5, 1 1S5, 1 3V4

CAPACITORS

- 1 16 mfd 525PV electrolytic, 1 8 mfd 525PV electrolytic, 3 .1 mfd 200VW tubulars, 3 .05 mfd 200VW, 1 .01 mfd tubular, 2 .005 mfd tub., 1 .001 mfd tub., 1 100pf mica, 2 50 pf mica.

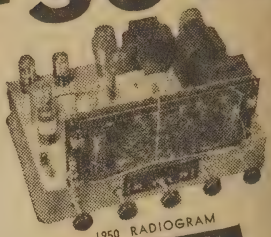
RESISTORS

- 1 10 meg, 2 3 meg, 1 2 meg, 1 1meg, 1 .5 meg potentiometer (with DPST switch), 1 .1 meg potentiometer, 1 .1 meg, 1 .05 meg, 1 .02 meg, 1 .01 meg, 1 15 ohm (all foregoing resistors ½ watt), 1 450 ohm 3 watt wirewound.

SUNDRIES

- 2 Terminals (1 red, 1 black), 4 knobs, 2 2-tag, 2 3-tag and 1 5-tag mounting strips. ½yd shielded hook-up wire, solder, solder lugs, hook-up wire, tinned copper wire, nuts and bolts, &c.

Radio Kit-sets



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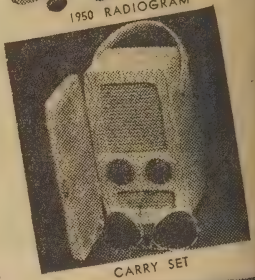

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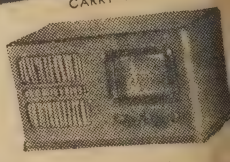
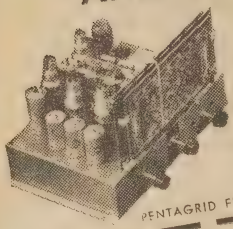
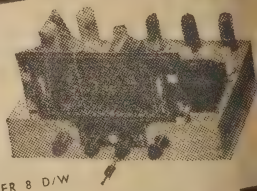


FIRESIDE 5

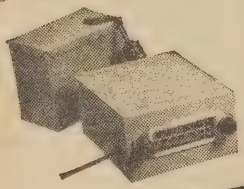


PENTAGRID FIVE



SUPER 8 D/W

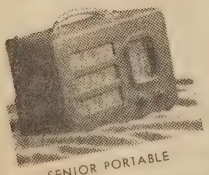
SPRINGTIME PORTABLE



KARSET

LITTLE GENERAL

TABLEGRAM



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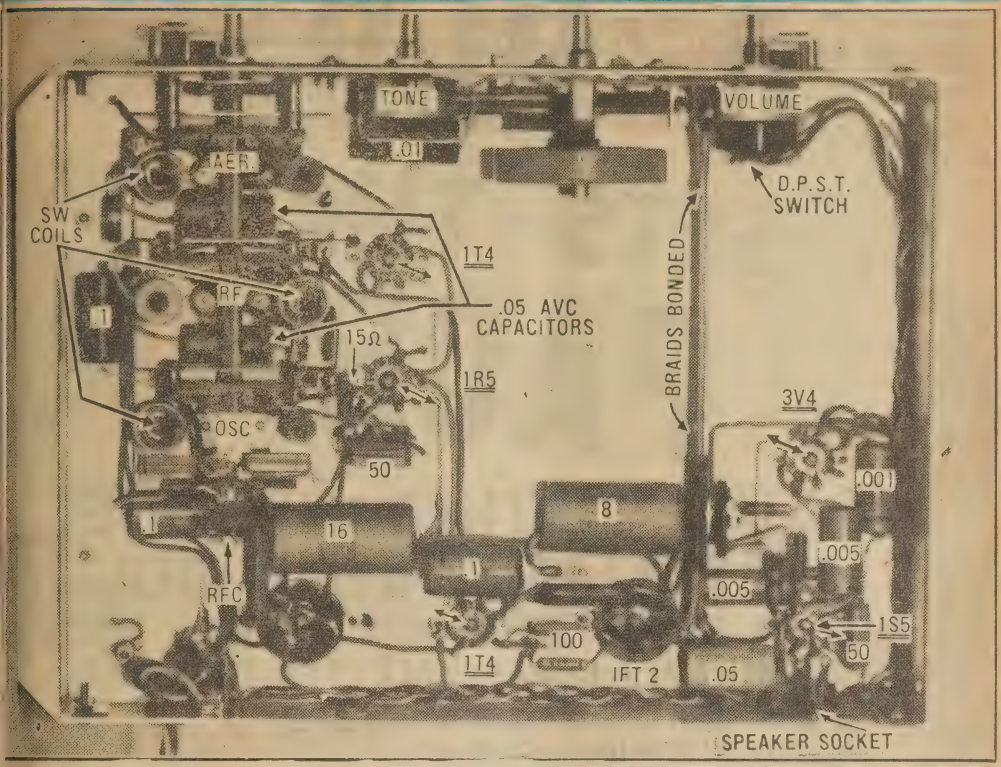
CODED UNDER CHASSIS VIEW OF THE RECEIVER



Studying this coded underchassis view in conjunction with the circuit diagram will give a clear idea where all components are placed. The arrow on each valve socket indicates the position of the gap between pins 1 and 7.

ive padding capacitor contained in
e unit.

To allow this feedback to function,
impedance which is high in com-
rison with the reactance of the
mfd. capacitor at RF is inserted
tween this point and the B-plus
e. In some sets the oscillator
ode dropping resistor can be made
perform this function.

However, with the 1R5 and similar
lves, a high capacitance electrolytic
required at the oscillator coil B
is point to avoid oscillator "flut-
" on short-waves caused by audio
dback via the B-plus line. As
s electrolytic must be on the
illator coil side of the dropping
istor, it is necessary to use a con-
ntional RF choke between the
ctrolytic and the .1 mfd. capacitor
provide the high RF impedance
cessary for "padder feedback."

ONSTRUCTION HINTS

That's the story, in a somewhat
ndensed form, from the electrical
sign angle. However, of more
portance to the beginner are the
neral constructional hints.

In placing the miniature valve
kets in the holes provided in the
assis orientate them so that the
ip between pins 1 and 7 points
in the following direction—1T4 RF and 1R5 towards the centre line of the chassis, 1T4 IF towards the coil unit, 1S5 towards the rear corner of the chassis, 3V4 towards the coil unit. This arrangement allows for the shortest lead length and most suitable layout of other components.

The same idea of orientation applies to the IF transformers. Locate them in their respective holes, so that the lead from the "G" pin of IFT1 to the 1T4 IF socket and the lead from this socket to the "P" pin of IFT2 makes the shortest run.

The usual procedure of running a length of tinned copper wire around the chassis and soldering it to solder lugs placed under various nuts should be followed. This allows for easier wiring and avoids trouble from "bad earths" later on. To give you a lead in this direction, we placed solder lugs under both holding-down nuts of the 1T4 RF and 1R5 sockets, under both nuts holding the gang rear mounting bracket, under the outside nut of the 1S5 socket and under the inside nut of the 3V4 socket.

RESISTOR COLOR CODE

VALUE	BODY	END	DOT
10 megohms	brown	black	blue
3 megohms	orange	black	green
2 megohms	red	black	green
1 megohm	brown	black	green
.1 megohm	brown	black	yellow
.05 megohm	green	black	orange
.02 megohm	red	black	orange
.01 megohm	brown	black	orange
15 ohms	brown	green	black

MOUNTING STRIPS

Tag mounting strips are used for ease of component mounting. Place the 5-tag strip near the battery cable inlet hole, a 3-tag in the hole provided behind the 1R5 socket, a 2-tag under the 1T4 IF socket nut nearest the IFT2, another 2-tag under the IFT2 nut nearest the 1S5 socket and a 3-tag in the hole provided near the 1S5 and 3V4 sockets.

The coil unit is secured to the chassis by the control shaft mounting on the front face and by two bolts at the rear end of the main plate. Each of these bolts carries three nuts as the main plate of the unit is spaced about 3-8in from the chassis.

The first step in the wiring is to

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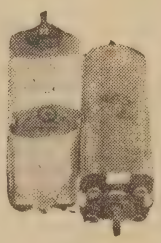

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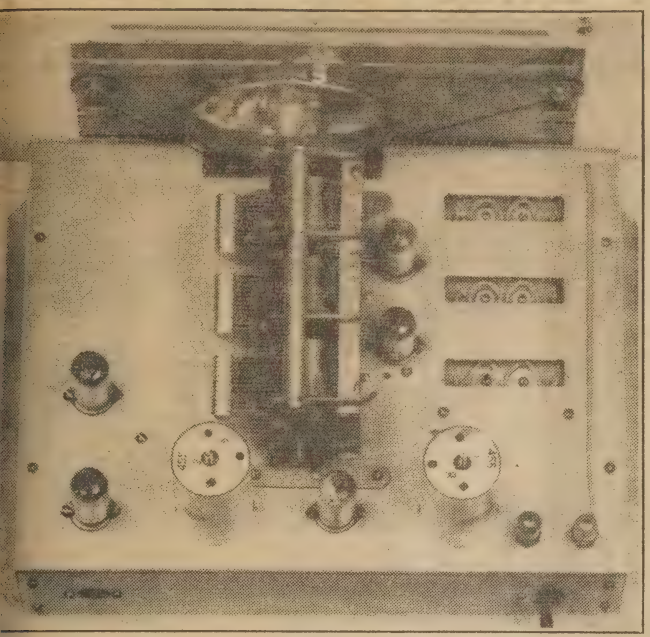
"Q PLUS"

"Q PLUS"

TOP CHASSIS VIEW OF THE SET



Note slots in chassis for access to coil slugs and trimmers on unit. When mounting dial, remove drum from back plate and "float" on gang spindle. The two dividing plates between gang sections may be bonded to lug under inside bolt of first two valve sockets.

:th the negative side of the fila-
nt and the centre spigot at each
:ket. Wire in the filament run, the
:ds from the battery tag-strip to
: switch on the volume control and
other leads which run from valve
:ket to valve socket, from valve
:ket to IF transformers, and from
l unit to valve sockets, &c. The
rial lead runs from the aerial ter-
nal through a hole and along the
) of the chassis to enter again at
: front edge for connection to the
l unit.

The AVC connections to the coil
it are simple. Connect the .1
:gohm resistor between the tag
ips in the RF and converter com-
rtments, taking a run from the
ter to IFT1 and the 2 meg. con-
:ted to the "F" pin of IFT2. The
mfd bypass capacitors at each
e of the .1 megohm are located
:ainst the unit main plate in each
the two compartments mentioned
:th the earth side soldered to the
:aid bonding the unit main plate to
: nearest solder lugs at the 1T4 and
: 1R5 sockets.

NDERNEATH PHOTOGRAPH

The underneath photograph shows
:se components in position. Take
:e not to damage any coil connec-
ns when slipping these compo-
:nts into place.

The .1 mfd RF bypass on the B-
:s is located at the B-plus tag in
: centre compartment of the coil
:it.

For the mounting of the compo-
nents associated with the B-plus supply to the oscillator section, there is a spare tag conveniently located on the 5-tag strip mounted at the rear edge of the unit main plate. The RF choke connects from the oscillator B-plus tag to this spare tag which carries the junction of the choke, the .01 megohm dropping resistor and the 16 mfd electrolytic capacitor. The other end of the .01 megohm resistor connects to the B-plus point on the battery cable tag strip behind the unit. The .1 mfd bypass connects from the oscillator B-plus tag to the tag alongside it to which the short wave padding capacitor is connected.

IR5 GRID CIRCUIT

The 1R5 oscillator grid capacitor and resistor are mounted on the 3-tag mounting strip near the 1R5 socket. The oscillator grid lead from the unit to this tag strip and thence to the rear section of the tuning gang should be kept as short as possible, as should the grid leads from the other compartments to the two valve sockets and the other two gang sections. The RF and oscillator plate leads from the unit are taken down behind their respective switch wafers direct to the valve sockets.

All other wiring is straightforward, the underchassis photograph giving whatever information may be necessary. In the case of the shielded wiring to and from the volume control, arrange it so that it is strung fairly taut between the volume control contact lugs and the 2-tag strip

N.H.V. KITS

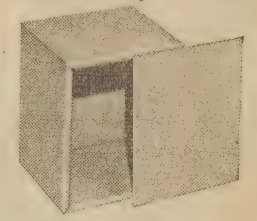
AMPLIFIER CABINETS

These streamlined amplifier foundations units consist of a standard chassis 3" deep with removable top in aluminium. Fitting over the top is a removable cover which has louvres on all sides and handles welded to the ends. Color Grey.

Catlaogue No.	W	D	H	Price plus Sales tax
AC1	10"	5"	9"	£1 8 0
AC2	12	7	9	£1 15 9
AC3	17	7	9	£2 3 0
AC4	17	10	9	£3 0 0

Catlaogue No.	W	D	H	Prices-plus Sales Tax
AC SF 1059	10	5	7½	£1 15 9
AC SF 1279	12	7	9½	£1 19 0
AC SF 1779	17	7	9½	£2 11 0
AC SF 17109	17	10	9½	£3 5 6

Metal Utility Cabinets



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MC596	5	6	9	9/4
MC7810	7	8	10	13/9
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MC81010	8	10	10	17/-
MC81112	8	11	12	21/-
MC7915	7	9	15	21/-

Catalogue No.	D	W	H	Prices plus Sales T.
MCSF776	7½	7	6½	11/6
MCSF796	7½	9	6½	13/9
MCSF7116	7½	11	6½	16/-
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nounted under one of the nuts hold-ng the IFT2.

Spot the two braids together and se the braid as the earth return for he "lower" end of the volume con-rol, the braid connecting to the earth ag of the 2-tag strip mentioned. lip a short length of spaghetti over ne braids where they pass the 3-tag trip carrying the B-plus point for he screen and anode resistors of the S5.

Make up the battery cable with ook-up wire in four different colors. f you can't arrange this, make sure hat you clearly label the leads to void any disaster at a later date.

CHECK FOR SHORTS

Make a check for any unintentional connection between B-plus and -plus with the aid of a multimeter r by the following method. Solder couple of short stiff leads to a orch globe and with the valves out f their sockets but with the batteries connected and the set switched n, "plug" the torch globe into the ilament pins of each socket. If he globe glows in each position, all s well and you will know that it is afe to plug the valves in after first witching the set off. Torch globes re much cheaper than valves!! See hat you get the right valve in the ight socket.

Switch the set on with the aerial ttached and find a station on the roadcast band. Align the slugs in he IF transformers for loudest sig-al. Now tune in a station toward he low frequency end of the dial nd adjust the slug in the oscillator oil so that this station is received t its correct spot on the dial. Whilst till tuned to this station, adjust the lugs in the RF and the aerial coils or the loudest signal.

Tune in a station toward the high requency end of the dial and adust the oscillator trimmer so that his station is received at its correct pot on the dial. Keep tuned to this tation and adjust the RF and aerial rimmers for loudest signal. Finally, wing back to the other end of the ial and check the setting of the scillator coil slug.

S/W ALIGNMENT

Incidentally, don't be caught by twiddling the wrong slug on the wrong band. You will easily see which is a broadcast or a short coil slug by noting the size of the coil. The short wave coils are the ones of larger diameter and wound with a single layer of heavier gauge wire.

On the short wave band, go through the same procedure with the short wave coil slugs and trimmers. The actual positioning of these stations on the dial is not as critical as on the broadcast band. The main point is to adjust the oscillator slug so that a group of stations falls within its particular band. Either the 42 or the 49 metre band will do for this adjustment. For adjustment of the oscillator trimmer you could use the 16 or 19 metre band.

To assist the uninitiated, we have available through the 1/- Query Service a pamphlet entitled How To Align a Superhet Radio Receiver.

You will find that it is a good plan to attach an earth wire to the set.

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FROM THE SERVICEMAN WHO TELLS

The elimination of hum is normally looked upon as a routine job, but experience shows that a serviceman should take nothing for granted—there is always that new fault ready to puzzle even the old hand at the game.

WHEN I infer that hum is a relatively simple fault, I am speaking purely from a serviceman's angle, where one can assume that the set was initially satisfactory. In these circumstances it generally means that an electrolytic condenser has cracked up or, in rare instances that a heater-cathode leak has developed in one of the amplifier valves. In either case, tracking down the trouble is not particularly difficult.

Of course, in a new piece of equipment, particularly of the high gain type with bass boost, microphone channels, &c., hum can present some very sticky problems, but that's another story.

As you may have guessed, the above remarks are prompted by a hum complaint with a rather unusual cause, but perhaps I'm getting ahead of myself.

A PA FAULT

It began when I had to service a small PA amplifier belonging to a local club. It was a portable affair in two small carrying cases, one housing the amplifier and the other the speaker. The amplifier used 6SJ7 valves in the preliminary stages with two 6V6's in a push-pull output stage. The rectifier was a 5V4.

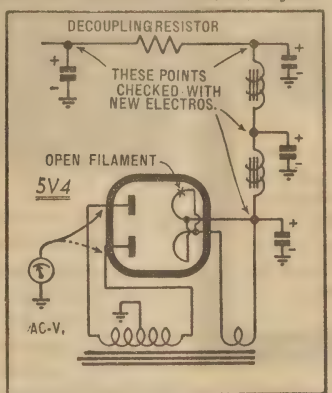
Main complaint was low volume accompanied by "a very tinny tone." It was also mentioned that there was "a lot of static when you turn it up." Testing the job on the bench confirmed the complaints as well as revealing quite a solid hum level.

The "static" turned out to be a noisy volume control, so I replaced this immediately, and then turned my attention to the distortion. The hum, I decided, would probably be fixed by replacing one or more electrolytics, and could be set to one side for the moment.

The microphone was a crystal type and, as we had recently had a bout of wet weather, I was inclined to suspect that this might be the trouble. Nevertheless, I decided to give the amplifier the "once over" for any obvious trouble, particularly as it seemed to have led a rather hard life, being dragged from one venue to another, carried in all kinds of vehicles in all kinds of weather. It apparently had not had any kind of service for many a long day.

A voltage check revealed nothing serious, although the HT was lower than I would have expected. However, without going into the design of the circuit, it was impossible to say that this was not as it was intended to be. General sensitivity seemed to be quite good, and I was more than ever coming to the conclusion that the microphone was the offender.

In this case the quickest way to test was by substitution, as I happened to have on hand a crystal insert. Connected across the input jack it produced normal quality and volume. Just to make sure I measured the resistance of the old crystal



Failure of one half a 5V4 valve produced hum by causing it to operate as a half-wave rectifier.

with the vacuum tube voltmeter, and found it to be a little under .5 meg. Remembering my previous experience with one belonging to an amateur friend, I knew it should be higher than this, nearer 15 meg., and decided that this one had "had it."

In the case of my amateur friend, we managed to save the situation by dehydrating the insert in a bottle of silica gel, but in this case I decided against anything of this nature. Such repairs can never be regarded as definitely permanent and, while they may be all right for amateurs who know what it is all about, they cannot be recommended as a service to a non-technical customer.

On the other hand, it was an expensive microphone, mainly because of its elaborate chromium-plated case, and it seemed that the most economical repair would be to fit one of the new crystal inserts. At the same time there was the opportunity to improve performance, as a feature of these early crystal microphones is a rather peaky response with a metallic quality of reproduction.

Many of the lower priced modern inserts have a similar characteristic but some of the more expensive ones have a particularly smooth response and I had in mind one of the latter as a replacement.

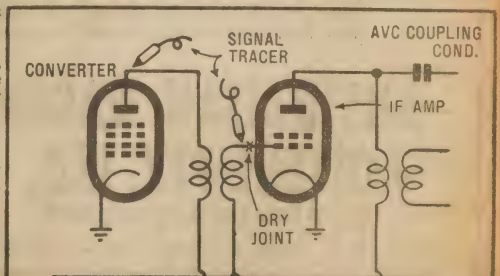
However, the owners pointed out that the system was used mainly for speech and, providing the results would be as good as before they considered that the cheaper unit would be quite satisfactory.

Accordingly I fitted one of these but was able to suppress the objectionable peak to some extent by resorting to a rather handy trick. The common yellow cloth duster seems to be particularly effective as a damping medium, and one or two layers of the material across the face of the insert will usually smooth out the response to a worthwhile degree.

ACOUSTIC FILTER

So it was in this case, two layers giving just about the required degree of suppression so that the final result was very pleasing. The construction of the microphone case was such that the new insert and its "filter" were quite invisible, so the finished product looked as good as new—and performed rather better!

But the hum was still there. Armed with a new electrolytic (and a lot of confidence!) I set out to track it down. First I bypassed the first filter condenser. A slight reduction here, but not enough to indicate it as the fault. Next, the second filter condenser—with much the same result. The third one (it was a two-section filter) also failed to respond, and I decided it was probably the



A signal tracer pin-pointed a dry joint under a valve grid cap.

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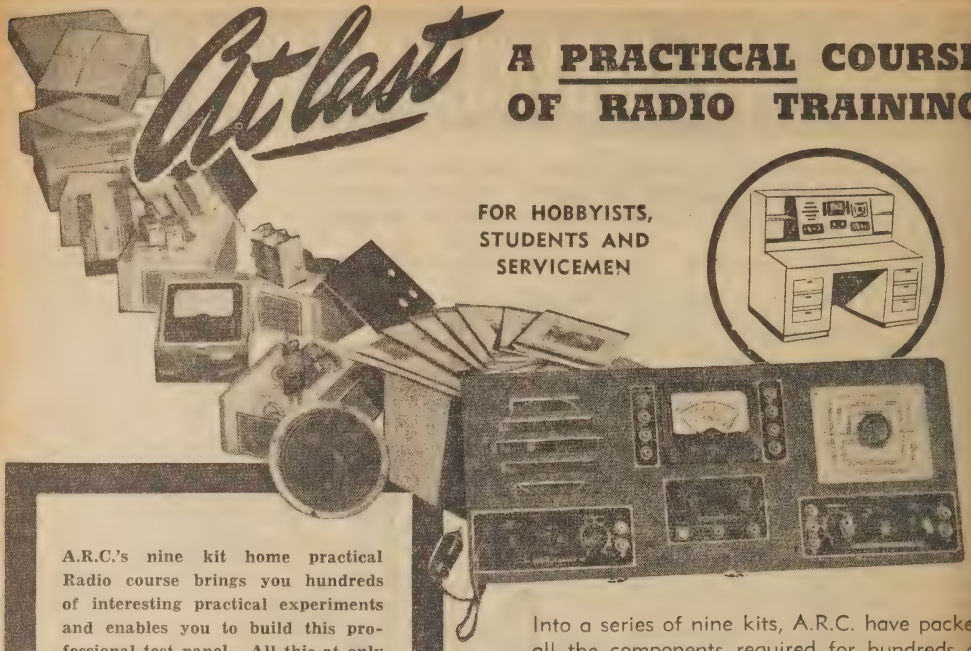

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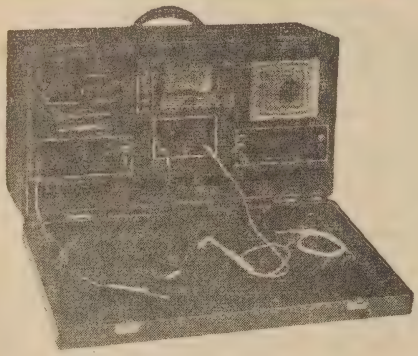

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ecoupling electro to the pre-
mplifier.

When this showed no worthwhile
nprovement it was obvious that a
ore methodical approach was
eeded.

Shorting the grid of the main amp-
fier reduced the level to some ex-
nt, but there was still a lot more
an normal. Next the HT was re-
oved from the plate and screen of
is stage and it diminished a good
al. The fact that the hum was
read over both stages seemed to
dicate that the trouble was in the
ain power supply. The plate cir-
uit of the output valves would
inimise the hum anyway, because
f the push-pull connection.

But if it was in the power supply,
here was the trouble? The "elec-
os" were OK, and there was not
uch that could happen to the
hokes without they failed com-
letely. That left the transformer
nd the rectifier. Perhaps one side
f the transformer secondary was
pen circuit? An AC voltmeter
heck gave the lie to this idea and,
s there was not much else that
ould happen to the transformer, that
ft only the rectifier.

And what could happen in a rec-
ifier to cause excessive hum? Per-
aps a dry joint in one of the base
ins, resulting in half wave rectifi-
ation with one plate being out of
ction. Or again, poor emission from
ne half of the filament, giving
uch the same result.

AULTY FILAMENT

I was about to remove the recti-
er for testing when I realised that
ie cause of the trouble was right
efore my eyes—only one of the
ilaments was alight.

Now in most cases this is an al-
ost impossible situation, for most
ectifier filaments are wired in
eries and an opening anywhere
eans a complete failure. On ex-
mining this valve more closely I
ound that the makers had wired
ie filaments in parallel.

Well! I ask you, who would have
ought of a dirty trick like that?

A new rectifier cleared the hum
nd I was glad to note that the HT
ad increased appreciably. The
eneral performance was now quite
mpressive, being particularly quiet
nd having ample sensitivity. The
wners went so far as to say that
had never been so quiet. I thanked
em for their kind remarks, but I
m afraid I have reached the stage
here I take such statements with
grain of salt.

ETERIORATION

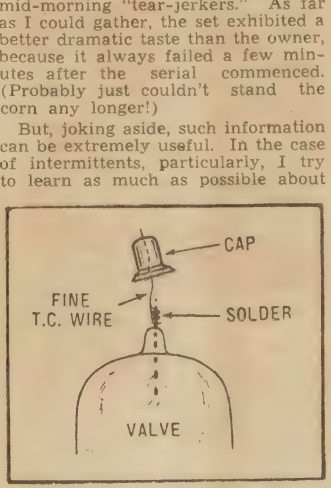
It's not that the person making
em is not sincere. In most cases
ey are, quite definitely. But it
not very often that results really
e better. In the above case the
stem was undoubtedly just as
m-free when new, as it was when
had finished with it, yet the owners
ere quite convinced that it was
tter.

What generally happens is that
ese troubles either have small be-
nnings and grow slowly or else
ey are not observed when they
st occur. They are then accepted
normal. By the time the set has
to be serviced for some more ob-
vious fault, its original performance
has been completely forgotten, hence
the "better than ever" compliment
for the serviceman.

Another intermittent reared its
ugly head this month. (Have I ever
mentioned that I don't like inter-
mittents?)

This time it was a mantel set, used
mainly by the housewife to hear the
mid-morning "tear-jerkers." As far
as I could gather, the set exhibited a
better dramatic taste than the owner,
because it always failed a few min-
utes after the serial commenced.
(Probably just couldn't stand the
corn any longer!)

But, joking aside, such information
can be extremely useful. In the case
of intermittents, particularly, I try
to learn as much as possible about



Showing how a repair was effected on a valve having a dry joint under the grid cap. The added fine wire helps to make a good job.

how and when things happen. In this
case, I was able to establish that the
set was always switched on a few
minutes before the session began, and
failed not long after, so that the total
time before failure was only about
five minutes.

The regularity of the failure sug-
gested that heat was effecting the
fault, while the short time suggested
that it was fairly close to the source
of heat. The most probable location
then was in, or near, a valve, and it
remained to find which one.

To the owner, the regularity of the
failure had been one of its most
annoying features, but to me it was a
most helpful one. A "reliable" fault,
if one may use such a term, is not
only easier to find, but it also en-
sures that the fault you rectify is, in
fact, the cause of the trouble.

This latter point is a most import-
ant one and I have known of more
than one case where a fault has been
found and fixed, with the full con-
fidence that it was the cause of an
intermittent effect. Even prolonged
running extending to several days
had failed to reveal any further
trouble, and the set was returned to
the owner — only to exhibit exactly
the same fault a week later.

Believe me when I say that errors
like that, while perfectly excusable,
are not good for business.

However, to return to the story of
the mantel set, from which I seem to
have strayed—

I decided first to observe the effect
of the AVC and so discover which
end of the set was giving trouble.
One way to do this is simply to con-
nect a voltmeter across the self-bias
resistor of the IF valve. In this
case, back-bias was employed, so
that such a scheme was not prac-
tical, although it would have been
possible to obtain the same result by
measuring the cathode current of the
valve. However, this meant unsol-
dering leads and it was easier to
measure directly from the AVC line
with the vacuum tube voltmeter.

With this connected, I switched on,
noted the AVC voltage generated by
our local station, and waited. Sure
enough, in about five minutes, signals
dropped to a whisper, and the AVC
voltage dropped to zero.

This meant that the fault was in
the "front" end of the set, some-
where up to and including the plate
circuit of the IF valve.

To narrow things still farther, the
signal tracer was now connected to
the plate circuit of the converter, and
after the set had been allowed to
cool, I tried again. The process of
warming up was repeated exactly,
and the tracer indicated that the
converter was not at fault, so the
next check was made right at the
grid of the IF valve.

Signals were quite strong here
also, which only left the valve and
a few components immediately as-
sociated with it. The fault seemed
quite content to remain while I care-
fully probed around the socket and
measured plate and screen voltages.
Everything appeared normal and,
since the bias system was common
to both the converter and IF valves,
it would be reasonable to expect any
fault here to show in the converter
section.

VALVE SUSPECT

The area of the trouble, together
with the evidence of the heating
effect, all pointed to the valve, which
had been under suspicion from the
first, but, as I said, it is as well
not to jump to hasty conclusions in
cases like this.

Now that it seemed reasonably
certain, however, I plugged in an-
other valve which was known to be
good and, while waiting for things
to happen (if they were going to)
I tested the doubtful valve in the
emission tester. It tested "good"
but I decided to see if it would con-
tinue to do so over a long period.

In about 15 minutes the emission
dropped to zero, while the set con-
tinued to play long past its normal
failure time. The confirmation by
the tester was something I had
hardly hoped for, since the test was
only between cathode and grid, and
the fault could have been in any of
the remaining electrodes. However,
since it had shown up, it was ob-
viously in either the cathode or grid.
I exerted slight pressure on the grid
cap, and the emission was back to
normal—clearly a case of a dry joint
between the top cap and the lead
wire.

Then the question arose as to
whether the valve could be repaired,
for it was obviously a new one, the
set itself being only a recent model.
It seemed a pity to discard the valve
for what was really a trivial fault,

(Continued on Page 89.)

Let's Buy An Argument

Having stuck my proverbial neck out on the subject of current flow, I must perforce be willing to take all that is coming. We will let Mr. Kelly of Coogee, NSW, be the spokesman for those who disagree with the views expressed.

by W. N. Williams

WHAT started it all, of course, was my deprecation last month of the practice in some text books and colleges still to foster the traditional idea of current flow, rather than to let it die a graceful and a natural death. Since electron flow IS current flow, I suggested, let's recognise once and for all that its movement is from negative to positive.

To do Mr. Kelly full justice, we have reproduced his letter *in toto* on the opposite page. Let's proceed then to debate his arguments without, I hope, reaching the "choose your weapons" stage.

In the first place, I don't agree that the question is an "old bogy," any more than direct coupling or perpetual motion. All these subjects are capable of examination and resolution into hard, cold facts. Whether we're prepared to accept these facts is a purely personal matter.

The second paragraph bears its own testimony to the weakness of Mr. Kelly's argument. It infers—and I think the inference is fairly drawn—that he must resort to special cases to produce possible examples of charged-particle movement in the positive-to-negative direction.

The important consideration, however, is not the internal workings of a battery or a generator but what goes on in the load circuit. That is the thing which governs the design of lamps, valves, motors, and a thousand other devices which rely for their operation on the flow of electric current.

A battery or generator is merely a device for producing electrical pressure and no useful work is done until the connection of an external circuit allows current to flow. And when it does flow, it can be resolved fundamentally into the movement of electrons.

But what does happen inside the battery? Which way does the current flow in its dark recesses? Or does current flow at all?

There are good reasons for answering the last question in the negative, on the ground that the word "flow" infers the movement of electrons (or something else) through the device from one side to the other—and this does not happen!

Accepted theory is that the initial creation of an electrolyte produces positive and negative ions in the liquid, which are normally stable. When suitable electrodes are placed in the electrolyte, a separation takes place, the positive ions gathering at one pole and the negative ions at the other.

By definition, the electrical pressure which results is fundamentally the result of a deficit or surplus of electrons at the respective poles. Up to this point, no current has flowed THROUGH the battery. The process has fundamentally been one of separation, the respective ions in the electrolyte tending to favor one spot or the other.

When the poles of the battery are joined through an external circuit the electrons do exactly what is expected of them, the surplus at the negative pole moving through the external circuit to make up the deficit at the positive pole.

Inside the battery a chemical action takes place which keeps up the supply of ions at the poles and gradually reduces the electrolyte as the process. In other words, the "works" of a battery can best be regarded as a chemical storehouse which, by electro-chemical action creates an emf across its terminals. There is a movement of charged particles WITHIN the battery but not THROUGH it.

On this basis, it is strictly incorrect to talk about the "internal resistance" of a battery, as if it were an electrical quantity, impeding the internal flow of current.

The limitation on current has to do with the amount of chemicals available in the battery and the su-

ce areas which are subject to emical action.

The expression of internal battery sistance in ohms is a convention hich lends itself conveniently to ectrical calculations. Fortunately, does not lead to confusion or conadiction.

Mr. Kelly's further reference is to sitive ions which stream in the posite direction to the electrons in gas discharge tube.

They move in the opposite direcn, to be sure, but they do not flow HROUGH the tube. Their action is irely local and catalytic.

Electrons leaving the cathode ike atoms on the way, and knock f electrons which join the prossion to the plate. The gas atoms, us ionised, move toward the cath-e, where they pick up other elecns, are duly de-ionised and again come subject to bombardment.

ATALITIC ACTION

Thus, the movement of positive ns is not THROUGH the tube at l. It is merely a local rotation om the free space in the envelope the cathode and then back again to free space.

The presence of the gas merely creases the total number of ELECRONS flowing through the tube id avoids the physical difficulties putting the plate very close to the thode in an effort to achieve low ternal resistance. So much for at.

I agree that it is not difficult to terchange positive and negative ncepts on an algebraic basis, but hy do so when it bears no relation fact? Or why use algebra to exse or cover up what is an admitted istake on the part of our forbears? And again, is it true that current ow is not universally identified ith particle movement in a particur direction? I suggest the only ies who would not have accepted ie "theory" by now are the "behiskered diehards" I referred to st month or others who, for reasons st known to themselves, have taken ff on a completely new line of ought.

IGHT OR LEFT HAND?

As for difficulties in the study of agnetism &c., Fleming's original les are based on the positive-toegative concept and they are just nother source of the confusion I mplained about last month. Some xtbooks have modified the rules conform to electron rather than rrent flow, but others persist with ie idea of using the original rules nd the explaining that allowance as to be made for Fleming's misken concept.

As for the idea of changing the asic concept of negative and posive charges, that looks very much ie hard way to me. Still, you never now, I might be wrong!

In the meantime, my observations the last issue were pretty solidly ounded. Even that famous, that raditional, that conservatively-amed manual, the Admiralty Hand-book of Wireless Telegraphy stated in 1931:—

When the poles of a battery are joined by a metallic conductor, the "electric current" which flows "from positive to negative" in accordance with the ideas of early experimenters, is really an electron current flowing from negative to positive.

It is convenient to use the older method of treatment, because of its greater familiarity, but in the explanation of certain facts, especially in the theory of the thermionic valve . . . &c.

True, my braided friends, and that "familiarity" is wearing awfully thin, after yet another twenty years.

The second letter, from Mr. Velarde, leads me onto ground which for a humble radio engineer, is somewhat slippery. However, I've been looking for an excuse to make these observations for quite a while and Mr. Velarde very kindly provides it.

If I pull a "phurphy" in the process and am duly shown up by someone better equipped with anatomical knowledge, it doesn't really matter, provided the truth emerges as a result.

In the first place, Mr. Velarde, the answer to your question is "yes." Notes which are heard simultaneously do tend to produce beats equal to the sum and difference of their frequencies. Beats are also produced between the harmonics of the notes and there are still other beats between the beats and the beats. As you observe, it goes on "to insanity."

The same theory applies as in a superhet mixer stage, where you get the familiar expressions . . . F1 plus F2, F1 minus F2, 2F1 plus 2F2, and so on.

CURRENT FLOW AND BEAT NOTES

Dear Sir,

Your remarks on the direction of current flow have once again raised an old bogy, "What is the direction of current flow?" For me the temptation of this bait is too much and I just must bite.

I would first ask you what do you consider to be the direction of current flow inside a battery, or for that matter inside any gaseous discharge tube or thyraton, where positive ions stream in one direction at the same time as negative particles stream in the opposite direction?

The only consistent way of defining the direction of current flow is to take it as the direction in which there is the transfer of an excess (in the algebraic sense) of positive over negative charges. This is essentially a mathematical definition of direction of current flow, and is convenient for the more analytical studies in electricity and magnetism:

If one is to suggest a change, surely it would be more logical to change the at present arbitrary concepts of what is a positive and what is a negative charge. Surely this is the root of the matter.

However, it seems to me that much ado is being made about nothing, since it is only necessary to consider the actual nature of an electric current in studying phenomena of electrical discharge in vacuo (as in a radio valve, &c.) and in advanced studies of the conductivity of metals and like subjects.

In all cases there is surely no difficulty in realising that a flow of negatively charged electrons in a given direction is equivalent (on the basis of the definition given earlier) to a current flow in the opposite direction. In nearly all such cases the considerations are qualitative rather than quantitative, and with very few exceptions, those people who are interested in electricity or radio would have at least gone far enough with secondary school education to grasp the signiicance o algebraic signs and apply it to this case. The only difficulty that could arise is that they might start off with an inadequate (or perhaps no) definition of current flow.

It seems to me that a difficulty is being made where in fact none need really exist. The fact that current flow is not universally associated with partical movement in a particular direction to my mind weakens the force of your arguments considerably; then add to this the fact that your suggestions could only add simplicity (superficial) to the more elementary considerations of electrical phenomena at the expense of complications in the more difficult analytical sections, and it seems to me that the argument breaks down completely.

In any case it would lead to confusion and difficulty when considering magnetic fields associated with current flow, and if a change having this effect were to be considered, why not go back to the beginning and re-define positive charge as being of the same nature as electrons.

K. G. Kelly.

Dear Sir,

I've been attempting to follow up the heterodyne effects of chords, but ran into difficulties. According to the rules, the four-note chord E G A and C forms 12 beat-notes—6 "plus" and 6 "minus." Do these beat together? And, if so, do the notes so formed beat together too and also with the original notes and the harmonics, and so on to insanity?

P. Velarde.

Eliminate noise

through feed back from power mains

Improve tone quality

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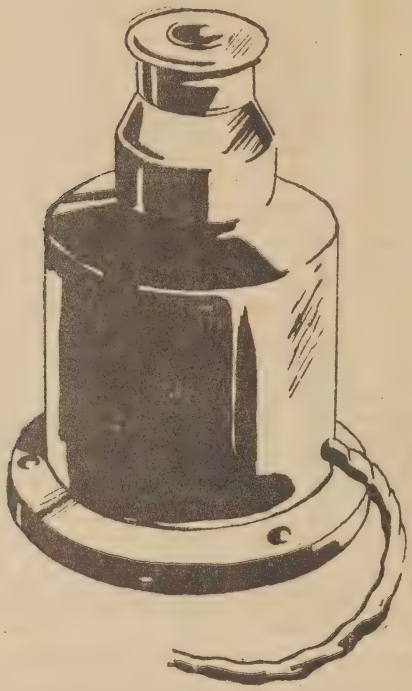
LINE FILTER



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Not all the beats are directly or—should we say—separately audible because they are often very weak. By using special amplifying equipment and tuned filters, it might be possible to trace a lot of them but for what purpose I can't imagine.

Without such equipment, the ear may be acutely conscious only of the predominant beats, particularly where they are discordant with the fundamental tones. Some we interpret with pleasure, the others are used by "modern" composers.

TUNING PROCEDURE

Instrument tuners rely a good deal on low order beats to set the pitch of individual notes. I remember running across, on one occasion, a set of organ tuning instructions intended for those with patience rather than a knowledge of the subject.

It involved playing specific notes simultaneously, then varying the pitch of the one to be adjusted until it was possible to count so many beats per so many seconds. When you had followed the procedure to its bitter end, the organ would allegedly be in tune.

The term "in tune" is, of course, a relative and conventional one because the tempered scale used by the "western" world is mathematically somewhat out of tune. This, in addition to natural harmonics.

MINOR BEATS

The net result, with a complex chord, is to produce a variety of minor but subtle beats which lend "timbre" to the music. We interpret it variously as anything from harsh to pleasing.

Electro-mechanical instruments like the Hammond organ are distinguished by the fact that their harmonics are, of necessity, exact frequency multiples of the selected fundamental. And, although the number and amplitudes of the harmonics can be varied widely, the tone structure of a Hammond chord is basically simpler than a comparable chord on an acoustic organ.

The fundamental simplicity of "Hammond" tone is generally easy to pick and is responsible for the observation I heard on one occasion . . . "Don't mind that man, he's only playing his amplifier."

HOW COME?

While all this is interesting enough, the real question is how we come to hear beats at all. As far as I can see our ability to hear beat notes is a function of the distortion inherent in the human ear. As we know from ordinary electrical theory, heterodyne effects cannot take place except in the presence of non-linearity.

I've tried recently to cross-check with various people about their sensitivity to beat notes and there does seem to be a definite variation. One man even maintained that he i frequently discomforted by beats between his own car engine and othe engines running alongside. I've never had that experience, as fa as I can recall.

After all, it is only reasonable t assume that there is a wide varia tion between the distortion factor in our individual ear-to-brain struc tures. Other things being equal, on would expect those with high dis tortion to be the more aware o beat effects.

A successful instrument tuner, fa from having good ears, may owe hi prowess to a high distortion content Quite apart from a very necessary knowledge of pitch, he may be aware of beats which the averag person just doesn't hear.

All this has an immediate bearing on our reactions to amplified music

Let's say that person "A" has a hearing system which introduces 2 pc distortion in a sinoidal pressure wave reaching the ear drum. Tha person will seldom have heard a pure sine wave and the whole of his interpretation of sound will be on the basis of original plus 20 pc distortion.

WHAT'S THE ODDS?

If his amplifier introduces another five pc distortion of the same general character—please excuse the broadness of expression—our friend A may not even notice the difference.

Person "B," on the other hand may have a particularly distortion-free ear-to-brain system and the 5 pc amplifier distortion may stand out like a shag on a rock. A and B may both be musically educated and their reactions to the amplifier will differ purely on physiological grounds.

I guess that gives every fan the right to specify the kind of amplifier which sounds good to him. But, if you are out to entertain your friends, you better get out the instruments to make sure where you are. One of your friends may hear distortion which is completely lost on you.

WOMEN AGAIN!

One other point. Have you ever noticed that women generally cannot stand loud music as well as men? Quite apart from psychological differences, they often show a definite "pain" reaction to sound or music which is just "loud" to a man. I've noticed it so frequently that there must be some common explanation.

Is the dynamic range of female ears more restricted than male ears? Are male ears more accustomed to noise than female ears? (I could suggest a reason for this.) Is the threshold of pain higher? Or does a higher distortion content in female ears turn loud music into an intolerable mass of intermodulation?

As a quaint old ABC character used to ask . . . "Well, chums, Mr. Walker wants to know."

ABSOLUTE PITCH?

Dear Sir,

While glancing through the May 1951 edition I noticed the remarks concerning "absolute pitch."

Dr. Percy A. Scholes, in the (1950) edition of the "Oxford Companion to Music,' devotes two pages to this subject and cites many instances of this faculty being possessed by musicions. However he definitely agrees that it is merely a remarkable ability to memorize a certain pitch, although the ability to do so may develop at a very early age.

It must be borne in mind that to a musician "absolute pitch" is a term used in contrast to "relative pitch." A single note possesses absolute pitch inasmuch as its position in the musical range of notes is established depending upon the agreed tuning pitch. But if this note is combined with others to form either a chord or melody we are immediately plunged into the realms of scales and keys and will then require the term "relative pitch" to define our original note from those of the harmony or melody.

There is thus a subtle difference in the meaning implied by a physicist as the latter bases his meaning upon an unchanging standard of vibrations per second.

Because a musician bases his sense of absolute pitch upon an arbitrary standard and may use relative pitch to distinguish between simultaneous or succeeding notes he is usually distressed by the adoption of a pitch standard that is new to him as the new that is new to him.

The results of tests conducted by Bacheb were reported in the "Journal of the Acoustical Society of America," Vol. 9, poge 146 (1937) and Vol II, page 134 (1940). That gentleman noted that the most accurate judgments were made by those who appeared to recognise a note according to some characteristc quality and then establish which octave it fell into according to pitch.

Bachem also reported good evidence to support the view that the gift is hereditary and cannot be acquired late in life nor unless a certain predisposition exists.

Because memory is merely the association of ideas, the most gifted of Bachem's subjects seem to link up with your opinion that "absolute pitch" is merely an acute sense of memory.

Competent anatomists would have us believe that pitch is determined by the fibres of the basilar membrane in the cochlea of the ear. It seems to me that for an individual to posses a sense of absolute pitch in the physicists meaning he would need another set of nerve fibres to tell his brain which ones of the basilar membrane were being excited.

K. R. Groom.

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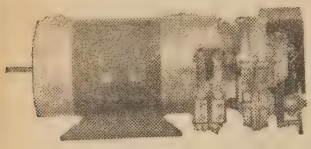

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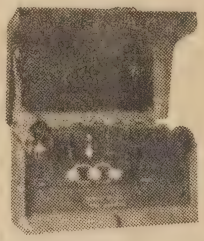

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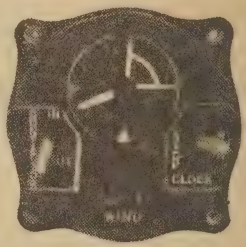

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PART 25—DEFLECTION AMPLIFIERS

In the last issue, we examined the basic requirements for electromagnetic deflection, the arrangement of the coils and the required sweep voltages. It is necessary now to examine the design of magnetic deflection amplifiers which provide the link between the basic saw tooth oscillator and deflection coils.

FOR the sake of clarity, it is necessary to consider the amplifiers as separate entities and to consider their individual design problems.

In actual practice, the designer of a complete television receiver would consider the vertical and horizontal deflection systems as respective circuit units and there might be some intermingling of the individual oscillators and amplifiers for reasons of economy.

By way of example, any non-linearity in the basic oscillator might easily be countered by a reverse characteristic deliberately introduced into the amplifier.

DESIGN OF SYSTEMS

Again, the relationship between the original sawtooth oscillator voltage and the current finally induced in the deflection coils depends a great deal on the ratio of resistance to reactance in the deflection output circuit. It involves the plate resistance of the amplifier tube and the external circuit constants, so that the oscillator and amplifier circuits must obviously be considered together.

Figure 1, however, shows an elementary circuit for a magnetic deflection amplifier. Consider first the frame circuit, which is the simpler case by reason of its low operating frequency.

The nominal field rate may be 50 or 60 cps but an extended frequency range is required to take care of the angular nature of the deflection pulse. While the maximum frequency would extend, in the ideal case, to infinity, it is usual to consider as adequate a response level to about fifteen times the nominal frame frequency. This would correspond to a limit of about 750 cps, which is still quite a modest figure.

OUTPUT COUPLING

To avoid passing the plate current of the amplifier through the deflection coil, thereby creating an initial deflection, it is usual to employ an output coupling system, being a simple R/C circuit in the case of figure 1.

Considering the low repetition rate of the frame oscillator, it is apparent that the coupling network must have a good low frequency response. This means, in effect, that the condenser must be a fairly high value, 8 mfd or thereabout being a common choice.

Since the deflection coil in figure 1 is energised directly from the plate circuit, it is reasonable to assume that the coil is of the high impedance variety. To establish some kind of a

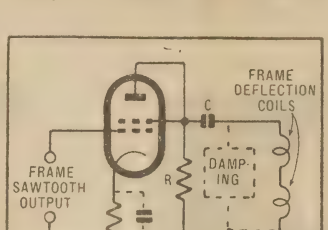

Figure 1: An elementary frame output amplifier using a triode-connected pentode valve. Purpose of the damping is explained in the text.

reference, it is suggested that the deflection coils may have a net inductance of about .75 henry, involving some 3000 turns and require a peak deflection current of 30 odd milliamps.

It follows that the standing plate current of the amplifier tube V1 must be substantially more than half th required peak value, so that a sma power tube would be the norm choice.

The story, however, does not en here because the design involves cor sideration of two closely relate matters, one being an expression frequency response and the other peak voltage due to counter emf.

The plate circuit of the deflectic amplifier, involving resistance an inductance, will have a characterist time constant, exactly as for an R/ circuit. Unless the time constant sufficiently short, the valve will n be able to effect abrupt changes i the current through the coil.

However, an immediate difficult arises in that abrupt changes in cu rent flow produce a counter en across the coil and this counter em becomes greater in magnitude as th time constant of the deflection ci cuit is lowered (or its frequenc range extended).

SHORT TIME CONSTANT

Taking first the matter of tim constant, it is given for an induc tive circuit by the expression:

T equals L/R

Where T is in seconds, L is i henries and R is in ohms.

It is noteworthy that increasin R shortens the time constant, whic is just the reverse of a circuit con taining only R and C.

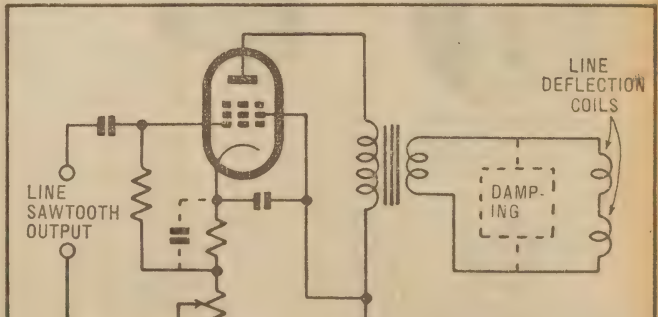

Figure 2: Fundamental circuit of a line output amplifier using a pentode and a coupling transformer to low impedance deflection coils.

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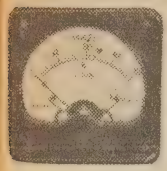

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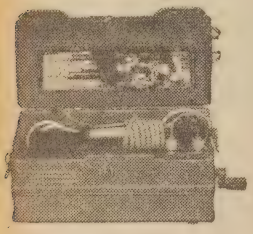

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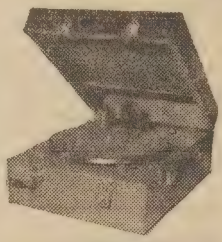

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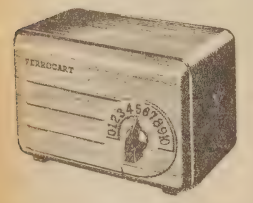

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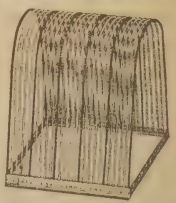

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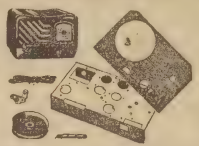

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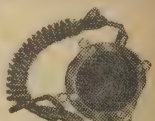

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With a field frequency of 50 per second, each complete field must occur in 20 milliseconds, or one-fiftieth of one second. Of this period, approximately 19 milliseconds will be occupied by the forward trace, leaving 1 millisecond for the flyback pulse.

The time constant of the deflection output circuit must be considerably shorter again than this, preferably about one-fifth of the flyback period or 0.2 millisecond.

Transposing the above formula, we have:

R equals L/T
equals 0.75 x 1000/0.2.
equals 3750 ohms.

In other words, the total series resistance, representing the output resistance of the stage plus the resistance inherent in the coils must equal or exceed the suggested 3750 ohms.

It follows that the plate load resistor R must have a value amounting to several thousand ohms while the valve should have a fairly high output impedance. The cathode resistor is commonly left unbypassed, which increases the output impedance considerably and further improves the linearity and response of the stage by reason of negative feedback.

The counter emf generated during the flyback pulse is given by the formula:

E equals L x I/T

When L is in henries, I is in amps and T is in seconds.

Substituting the approximate values already suggested, E is found to be about 25 volts, which is very small compared with the initial plate supply voltage. It can therefore be dismissed as having no bearing on the insulation problems.

A very different answer is obtained when the same reasoning is applied to the line deflection amplifier. Here the repetition rate is raised to over 15,000 per second and the flyback period drops, in round figures, to 10 microseconds or less

PEAK VOLTAGE

Taking the above formula but substituting 10 microseconds for 1 millisecond gives a counter emf of some 2250 volts. Adding to this the likely 350 standing volts on the amplifier plate and the total peak plate voltage exceeds 2500 volts.

This figure is likely to be conservative because the aspect ratio of the picture would demand a higher peak deflection current than for the framing circuit. Alternatively, if the current were maintained at the same value and the number of turns increased on the deflection coils, the peak voltages would still be pushed up as a result.

From a practical viewpoint, all this would lead to serious insulation problems, not only around the valve and socket but more particularly in the deflection coils themselves and the leads thereto. As a result, an alternative approach is normally adopted.

The procedure is to use line deflection coils comprising comparatively few turns of heavy gauge wire and an inductance which may approximate 5 millihenries—to quote a likely figure. This calls for a comparatively heavy peak deflection current, which might well approach one amp, the net impedance of the circuit being quite low.

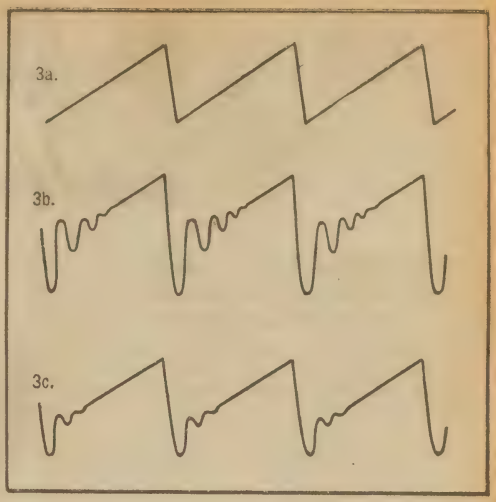

Figure 3a shows an idealised sawtooth current waveform and 3b the same waveform but with superimposed "ringing." 3c illustrates the effect of the damper.

The important point, however, is that the counter emf can be limited to between 100 and 200 volts, so that insulation problems are minimised, at least so far as the deflection coil and wiring are concerned.

To feed such a low impedance it becomes essential to use a matching transformer and its design calls for a great deal of care.

COUNTER EMF

In a typical case, it is likely to have a step-down ratio of about 10-1, which means that the counter emf across the primary circuit will be at the very least about 1500 volts. To this must be added the normal operating potential of the associated valve, so that the primary circuit as a whole must be very well insulated.

While this presents some problems for the designer, they are less formidable than they would be if the same degree of insulation had to be applied to the actual deflector coils.

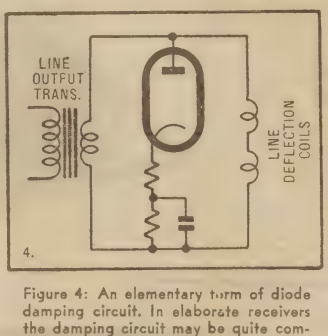

Figure 4: An elementary form of diode damping circuit. In elaborate receivers the damping circuit may be quite complicated and inter-connected with the line amplifier.

The efficiency of the transformer must be high, also, to minimise transfer loss between primary and secondary. Any such loss, which will amount to at least 25 pc, is reflected as an additional current and voltage requirement in the primary circuit. Taking such losses into consideration and also the additional deflection requirements of some picture tubes, the primary surge voltage can easily run to several thousand volts.

We shall see in a subsequent article how this surge voltage can surprisingly be put to good use, the line deflection transformer becoming one of the key items in a modern receiver.

Another vital design point has to do, of course, with the time constant of the primary circuit, the basis of calculation being similar to that already explained for the frame oscillator. The inductance value is generally somewhat lower but the time constant required is drastically reduced, being counted in microseconds.

As a result, the minimum amount of series resistance required in the circuit to preserve a short time constant may run to 0.1 megohm or thereabouts, which prohibits the use of a triode tube as the line amplifier.

SURGE VOLTAGE

The requirement is easily satisfied by a pentode or tetrode, however. The valve must be capable of withstanding, at the same time, very high peak plate voltages, it must be able to deliver high peak current to the primary and for the sake of convenience, it should not need to operate with too high an initial plate voltage.

Something like the required characteristics are found in the familiar 807, with its high power capacity, its plate-cap connection and its moderate plate voltage requirements. However, the demands of television receivers have led to the introduc-

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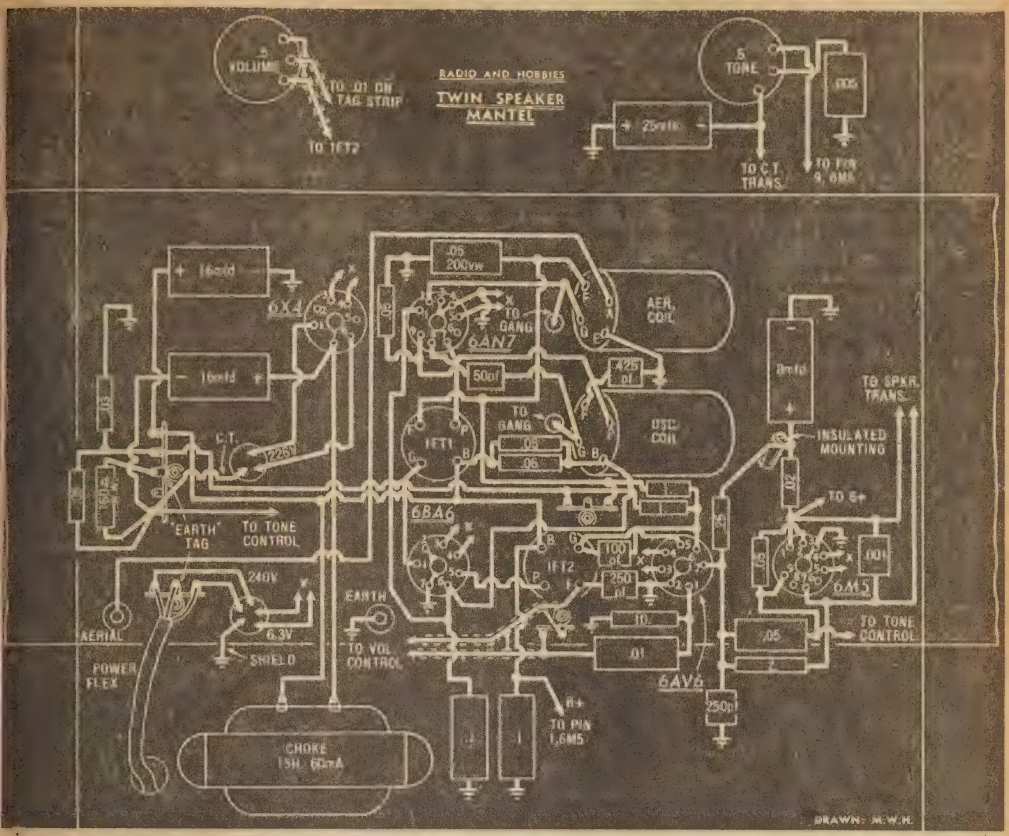


Here is the wiring diagram of the twin speaker mantel receiver described last month. Unfortunately there was insufficient space to include it in that issue.

A COURSE IN TELEVISION

ion of specialised tubes which are ogical developments from the 807 ype. Outstanding current example s the American 6BG6.

Figure 2 suggests a possible cir- uit arrangement for a line output tage using a pentode or a tetrode alve.

As in the case of the frame oscil- ator, the cathode circuit may not be ypassed and it may even contain variable resistor to modify the tage gain and linearity. Such a ontrol would, as previously stated, perate in conjunction with the saw- ooth oscillator controls to produce s near to a perfect sawtooth de- lection current as possible.

AN EXPEDIENT

The reader will appreciate that the lan of balancing one source of non- inearity against another, whilst cceptable in the end result, is essen- ally an expedient which is fraught vith difficulties and objections. This has led to the development of many and varied schemes to control amplitude and linearity, both of which vitally affect the image.

Quite apart from varying the operating conditions of the final amplifier, it is not unusual to find special compensating inductors and loading circuits either in series or parallel with the coupling transformer, each one affecting the trace in a particular way. Some are fixed, others variable to allow each individual receiver to be set up for the best picture characteristics as part of the alignment and adjustment procedure.

The final matter in this article arises from the fact that the deflection circuits do not comprise only resistance and inductance. Inevitably, there is present some capacitance and this resonates with the inductance at a particular frequency.

Excited by the sharp wave fronts, the circuit is likely to "ring" or, more explicitly, to generate a damped train of waves. These are superimposed on the sawtooth current waveform to produce an effect as illustrated in figure 3b. The effect on the picture is to produce vertical lines as the flying spot momentarily hesitates and accelerates on its way across the screen.

Seeing that resonance is inevitable, many designers adopt the plan of resonating the line deflection coils, together with the transformer secondary to approximately 70 Kc, which ensures a rapid flyback trace corresponding to the rise time of a single 70 Kc wave front. The oscillation cannot be permitted to continue, however, for the reason already mentioned.

Some form of damping is therefore required to prevent this high frequency "ringing."

In the framing circuit it may be nothing more than a loading resistor

(Continued on Page 93)

Here's your answer, Tom!

Tom's problems this month are no less diverse than usual and in spite of an academic flavor are of general interest. We quite enjoyed the first one, mainly because it gives us the opportunity to make a "corny" gag.

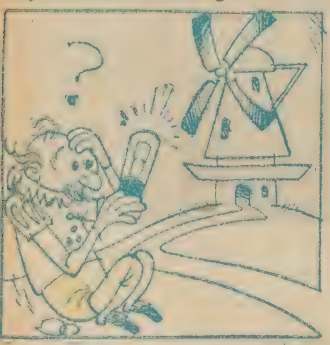
You mention in one of your articles that a pentode is used in preference to a triode because of Miller effect. Does the triode have a grinding effect on the signals?

No, Tom, it doesn't have a grinding effect although it does have a grounding effect. Grr.....r!

You see, Tom, "Miller" effect, which is very noticeable in certain valves, results in the input capacitance appearing to be very high, with the result that there is attenuation of the treble notes.

A man named Miller once wrote a very learned technical paper on the subject—hence the name.

Many generations ago his family may have had something to do with



flour mills but we have no definite information on the subject.

We could explain it all with figures and formulas but the average practical radioman is more concerned with the practical result.

If you arrange a valve in an ordinary circuit but with the load resistance temporarily shorted, it would be possible to measure a certain value of capacitance between grid and ground. This is known as the "input" capacitance.

In the case of say a 6B6-G valve, the value you would measure would be 3.4 pf and is equal to the sum of the capacitances between the grid and plate, and the grid and cathode.

If, however, you remove the short from the plate load and operate the valve normally you would find that the capacitance now measures something over 100 pf. How come?

Well Tom, the apparent input capacitance of a valve with a resistive load in the plate circuit is equal to the capacitance between the grid and plate multiplied by the stage gain of the valve, plus a little bit more.

Thus, when both the gain and the grid-to-plate capacitance are high, the apparent capacitance across the input circuit is also high. The high frequency signals are bypassed to earth, hence the pun about "grounding effect."

In the case of a pentode valve, the capacitance between grid and plate is extremely small so that, even though the gain is high, the Miller effect capacitance remains low. For this reason pentodes are often to be preferred to triodes in amplifier circuits where good high frequency response is desired.

Can I prolong the useful life of my valves by reducing the filament voltage, assuming that I am willing to accept poorer performance.

No, Tom. As a matter of fact you are likely to shorten rather than lengthen the ultimate life of the valves by reducing the filament temperature!

The exact reason for this effect, known as "cathode poisoning" has caused some lively arguments among the technical "long hairs." Apparently it is conected with the bombardment of the cathode surface by positive ions, when the "space charge" or cloud of negative electrons around the cathode is thinned out.

It is particularly important to operate the filaments of large, high-powered valves at the correct voltage, since there is more chance of there being some residual gas in the valve. Furthermore, the emission requirements of the filament are likely to be greater, too.

You have possibly observed that valves operating at high current, notably the rectifier and power valve in a domestic receiver, usually fail before the remaining valves in the set. Therefore, if you desire long life, operate the filaments as near as possible to the recommended voltage and arrange the associated circuit so that the total drain, and total power dissipation in the various electrodes are all well within the manufacturers ratings.

Valve manufacturers in certain instances suggest that valve filaments be operated at low voltages for certain special reasons, notably in low level preamplifiers where hum and noise are likely to be troublesome and in vacuum tube voltmeters where "secondary emission" is likely to cause reading error. In these cases the total current drain of the valve is invariably quite low and valve life is not the primary objective, anyway.

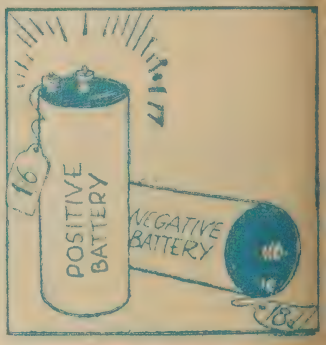
The rules governing modern "coated" filaments are quite different from those for the old pure tungsten filaments.

In the early days, it was the accepted practice to control the gain of such valves by varying the filament voltage. Apart from the fact that the distortion introduced from other sources was so high that a little extra didn't matter, it was an excellent means of economising on battery drain which was very high when compared with that of modern economical valves. Pure tungsten filaments don't suffer from "cathode poisoning" to any degree.

I have a 6-valve battery-operated receiver but I can't buy a new negative battery for it. Can you suggest how I can overcome the difficulty?

Quite frankly, your problem is a very difficult one from our point of view for we have not yet come across a negative battery or a positive one either for that matter! Your receiver must be something really special.

Seriously, though, we suspect that you are referring to the "C" battery, which usually has the positive terminal connected to the chassis and the various negative terminals



connected to points in the receiver. The battery manufacturers usually label one terminal of such a battery positive, and, in the case of, say, a 9-volt battery, the remaining terminals may be labelled —1½ volts, —3 volts, —4½ volts, —6 volts and —9 volts.

However, you could with equal justification label exactly the same battery in quite a different way. The —9 volt terminal could be marked simply minus, the —6 volt

terminal marked plus 3 volts and so on until the terminal previously marked positive would be marked plus 9 volts.

It's really just another way of saying the same thing. For instance, you could say that point A on a certain circuit is 3 volts positive with respect to point B but it would be equally true to say point B is 3 volts negative with respect to point A. It's simply the point of view.

Could you tell me how to adjust my crystal? I borrowed another crystal from a mate and my set works okay, so it must be in order. The serial number of my own crystal is KC7206.

Apparently, Tom, you are the victim of a word which can mean several things. It would appear that the crystal you have is one of the quartz variety, which is intended to control the frequency of a transmitter. This is quite different from the crystal used in a crystal set to detect signals.

The detector crystal has the essential property of passing current in one direction while resisting current flow in the opposit direction. It is usually a piece of carborundum or galena to use the common terms.

On the other hand a transmitting crystal is a slab of quartz which is so dimensioned that it can be made to vibrate very easily at a particular frequency. We generally aren't so much interested in the mechanical vibration as in the electrical energy at the same frequency. This can be tapped and used to control the frequency of an oscillator which, in turn, controls a transmitter.

The frequency of your crystal would appear to be 7206 Kcs. Unfortunately, it is not likely to be of much use either to you or even to a radio amateur, since it is outside the popular amateur bands.

What is spaghetti?

As far as radiomen are concerned, spaghetti is insulated flexible tubing. It may be of varnished cotton, nylex impregnated silk or nylex, to name three types that come to mind. In the smaller sizes it is useful for covering the bare leads to resistors, condensers and tinned copper wire while the larger sizes can be used as a neat covering for cables.

Of course we could crack the old gag about the chap who thought the only place you buy spaghetti is at the grocer's but that would be cooking up another story.

How long does it take for a sound to travel from a radio studio to my living-room?

Provided it doesn't get knocked out with an overdose of ether, it doesn't take very long at all!

Let's hope that crack isn't any harder to work out than the problem. Actually, Tom, it is necessary to know how far the announcer is away from the microphone, how far from the radio transmitter your receiver is situated, and so on.

Just to satisfy your curiosity, Tom we will work out an example where the announcer is speaking four feet away from the microphone, the station is 100 miles away from your receiver and you are sitting six feet away from the loudspeaker.

Sound travels at a velocity of 1100ft per second so we can add the distance that the sound travels in the studio and drawing-room to obtain the total distance over which the signal travels at 1100ft per second. In this case it is 10ft. The time taken is therefore 1/110th part of a second.

Radio waves travel at a velocity of 186,000 miles per second, so that they would cover the distance of 100 miles in 1/1860th part of a second. In other words, the signal takes a lot longer to travel the 10ft in the form of sound energy than it does to travel the 100 miles in the form of radio energy.

A certain amount of time is lost in travelling through the transmitter and receiver circuits. However, this is not likely to affect the final result a great deal. Another factor is the distance between the radio studio and the transmitter, which may be 20 or 30 miles in some cases.

If you want to be really academic you could consider the case when the signals are not received directly but rather reflected one or more times from the Heaviside layer, in which case the distance travelled by the radio waves may be more than 100 miles.

All things considered, the announcer's voice isn't likely to take more than 1/100th of a second to reach you and you could more than halve the time by the simple expedient of putting your ear in the speaker.

Fast? Yes, especially when one is accustomed to Sydney's trams.

I have often seen the letters "RMS" in your technical articles. What do they stand for?

That's a pushover, Tom. In electrical engineering the letters RMS stand for "root-mean-square." It is the square root of the mean value of the squares of the instantaneous values taken over a complete cycle.

No, Tom, don't stop reading, we didn't understand that last sentence at first reading either but the technical dictionary couldn't be wrong.

Perhaps we can be more helpful if we explain in practical terms.

As you know, alternating current varies its value and direction of flow in compliance with certain laws. If we were to draw a graph plotting current on one axis and time on the other, the result would be a sine curve. Don't worry if you are not sure exactly what a sine curve is but it looks something like a series of waves. Starting at the centre the line goes up to a maximum in one direction back to the centre, to a maximum in the other direction and back to the centre again.

In doing this it completes one cycle and provided the value of the current and the frequency stay constant, each successive cycle is the same as the first.

(Continued on Page 93)

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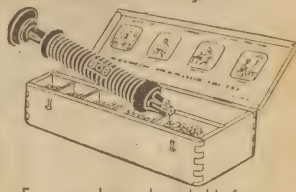

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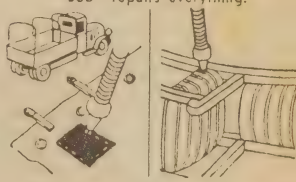

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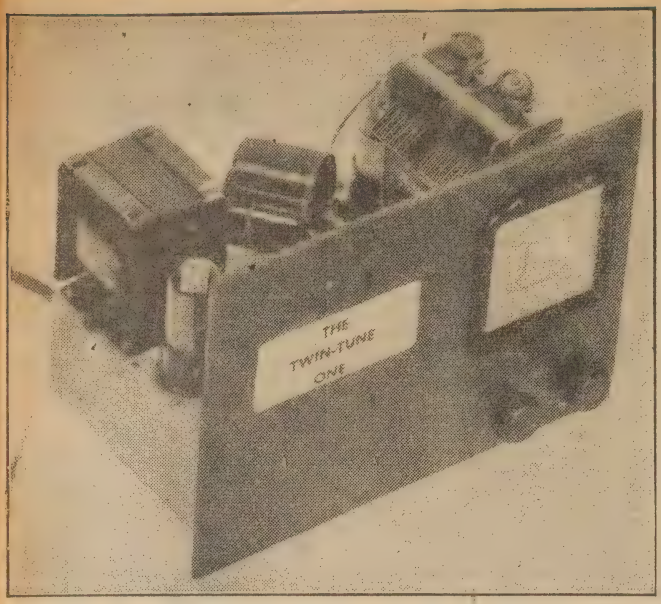


This front view of the Twin-Tune One clearly shows the location of the new valve, the rectifier, which is seen directly in front of the power transformer.

LEARN WHILE YOU BUILD

Well, how's it going? No doubt last month's amplifier has whetted your appetite for bigger and better things. OK then, this month we progress from battery operation to all mains operation, and the performance of your amplifier well be improved considerably. We also show you how to use the diode plate for detection.

by Philip Watson

FOR a start let us study the power supply. In order to operate the plate circuit of a valve we require a direct voltage, varying from the nine volts used in last month's set, up to about 250 volts for a standard receiver. The current required may vary from a fraction of a milliamp up to a hundred or more milliamps.

Where the voltage and current requirements are only moderate, say up to 90 volts at 10 or 12 milliamps, it is often convenient, though usually more expensive, to obtain this from dry batteries. When requirements go much above these figures, the use of batteries rapidly becomes uneconomical, so that sets which are designed to operate from batteries must be restricted in their power requirements, while sets with greater power requirements must use some other source.

SOURCE OF POWER

This other source can be the mains, but direct connection to these is usually impracticable for a number of reasons. Where the supply is alternating, as it generally is, it has to be changed to DC. As we will see, this is very much easier if we interpose a transformer between the mains and our changing device, and, as a transformer is also required to operate the filament, the various windings may conveniently be accommodated on the one core. The presence of a transformer also adds in some measure to the safety factor, as the amount of power it can supply is distinctly limited.

RECTIFICATION

The changing from AC to DC is known as "rectification," and, while this may be accomplished with a number of devices, by far the most popular is the valve.

To understand how this works take a look at figure 1a. Here we have a transformer developing the required voltage (say 225) across the secondary winding, that is, between points A and B. The resistor marked "load" is not necessarily a single physical resistor, but represents the load placed upon the power supply by the various requirements of the set. It may, therefore, be the combined effect of a dozen different circuits, such as plates and screens of valves, bleed and voltage dividing resistors, &c. But for the purposes of study it is easier to regard it as a single resistor.

ELECTRON FLOW

Now assume for the moment that A is positive with respect to B. The plate of the valve will be positive with respect to the cathode, so there will be a flow of electrons toward the plate and around the circuit, including the load resistor. The direction of flow through the load will be from B to C, and this will result in C being positive with respect to B.

Another way of visualising these conditions is to consider that the electron flow results in the cathode being connected to the plate, when it will be easy to see that C is connected to A, which is the positive end of the winding, while the other end of the load is connected to the negative end. Thus, almost the full voltage of the winding is applied directly to the load.

Now the above only holds while A is positive. When A is negative and B is positive, electrons are repelled from the plate, there is no connection between it and the cathode, no voltage is applied to the load and no current will flow through it. Thus a voltage of one polarity only will be applied to the load, and current will flow through it in one direction only. This uni-directional current is the first step toward DC, but much remains to be done. Since only the positive half of he cycle is used there will be a gap between each flow of current, equal to the unused negative half of the cycle (see fig. 1b). This is known as half-wave rectification.

To provide a steady flow of current we must store some of the energy

rom each positive cycle to carry is over the period when no power s delivered, and for this purpose we se one or more condensers. With uch a large gap between power urges it is extremely difficult to rovide enough capacity to ensure perfectly steady flow of current. f the flow is not steady, the varia- ions will be reproduced in the peaker or headphones in the form f hum.

To make the elimination of hum asier we resort to what is known s full-wave rectification, where the reviously unused negative half ycle is made to do the same job s the positive one, thus putting an xtra surge of power where there vas formerly a gap.

The manner in which this is chieved is quite ingenious, though asy to follow. Take a look at figure a, the top half of which is identical with figure 1a. In the lower half ve have an extra transformer wind- ng (D and E) and a second valve /2. Notice particularly that the oad is made common to both halves, ince this is one of the most important eatures of the circuit.

When the upper winding is posi- ive at A and negative at B, the ower winding is positive at D and egative at E. Under these condi- ions the upper half will function xactly as already described, while he lower half remains dormant as he plate of V2 is negative.

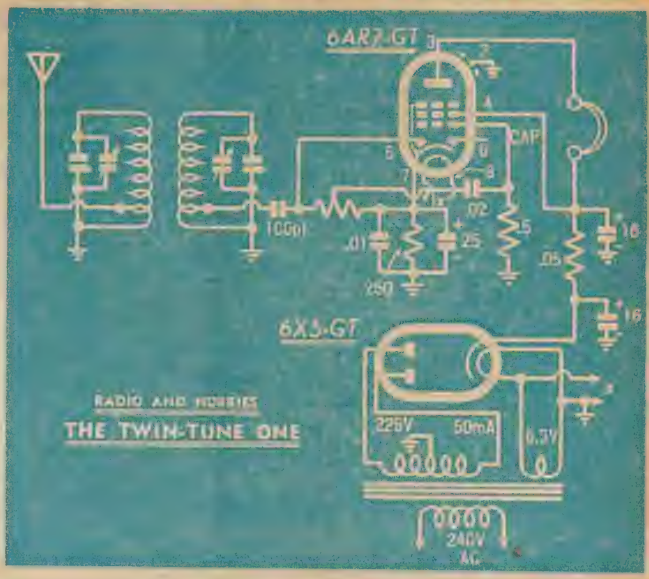
On the reversal of polarity E will ecome positive and D negative, so here will be a flow of electrons cross V2 and through the load re- istor from D to C. The important oint is that this flow is in the same irection, as far as the load is con- erned, as that produced by VI and he voltage across it will also have he same polarity. Thus we have eversed the polarity of the negative alf-cycle and made it take its share f the load. See figure 2b.

TAPPED WINDING

In practice the two transformer windings would be in the form of a single winding with a centre tap representing the junction between B and D, while the valves V1 and V2 would be twin units in a single envelope, with common heater and cathode circuits. In some cases this valve has no separate cathode, con- nection being made to one side of the filament. The operation is exactly the same, but the separate cathode is very convenient for certain cir- cuits.

A typical full-wave rectifier and filter system is shown in figure 3a, and the rectifier section should first be compared with figure 2a. If you feel confident that you understand this in the new method of presenta- tion we may pass on to a study of the filter section. The filter section is necessary because, even with full- wave rectification, the output is far from steady, and we must provide some storage to tide us over the gaps or, if you like, to "iron out the bumps."

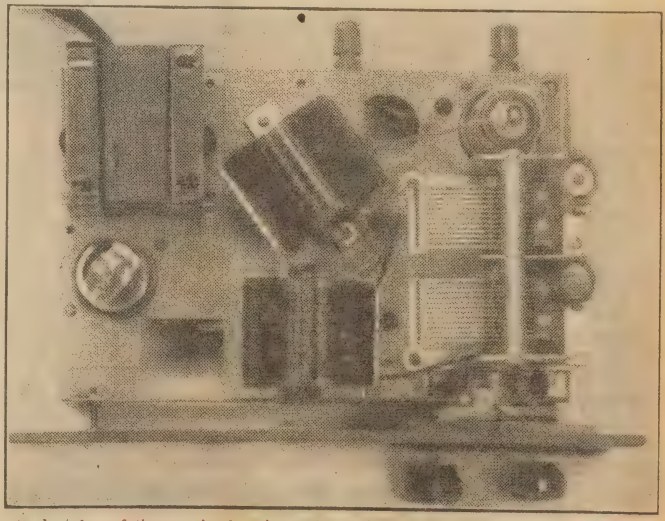
CIRCUIT DIAGRAM OF NEW SET



Compare this circuit with that of last month and the additional components forming the power supply will be easily recognised. Note that the diode has taken the place of the crystal detector.

The first storage point is the condenser CI, and to this is applied the fluctuating voltage from the rectifier. This is represented by the solid line in figure 3b. The first application of voltage to the condenser causes it to be charged, the voltage depending on the peak voltage from the rectifier (point A), and the energy stored depending on the capacity of the condenser as well as the applied voltage.

After reaching its peak at point A the voltage from the rectifier falls



A plan view of the set showing the position of all the major components, with the new rectifier valve on the left.

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Z 973-9	20	80	370	500
Z 1012-1	20	100	430	1000
Z 967-1	20	150	200	1000
Z 956-1	20	200	160	1000
Z 962-1	25/5	20/200	100	1000
Z 1011-1	15	250	160	1000
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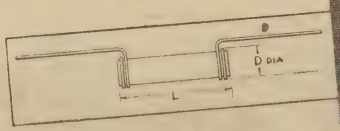

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CTH 310	1,000 pF	0.18"	0.4"
CTH 310	1,500 pF	0.18"	0.4"
CTH 310	2,200 pF	0.18"	0.4"
CTH 315	3,300 pF	0.18"	0.6"
CTH 315	4,700 pF	0.18"	0.6"
CTH 422	6,800 pF	0.22"	0.9"
CTH 422	10,000 pF	0.22"	0.9"

- FINISH: Dimensions shown are for Finish "C." For Finish "A" increase overall dimensions by 0.080".
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to zero at point B. However, the voltage across the condenser will remain at the full peak value unless the energy stored in it is discharged; which it normally will be through the load. As the condenser is discharged the voltage across it will slowly drop, the rate at which it drops depending on the rate of discharge and the capacity of the condenser. The larger the condenser, or the smaller the discharge, the slower will the voltage drop.

In 3b the dotted line represents the voltage across the condenser, and it will be seen that during the time the output from the rectifier drops to zero and commences a new cycle this has only dropped to the point C, where the rising voltage from the rectifier again takes over and charges the condenser to full voltage. As already explained, the slope of the line AC will depend on the discharge rate of the load, as well as the capacity of the condenser. Where the discharge rate is low this line will remain almost level with the peaks from the rectifier, and the job of filtering is made very much easier.

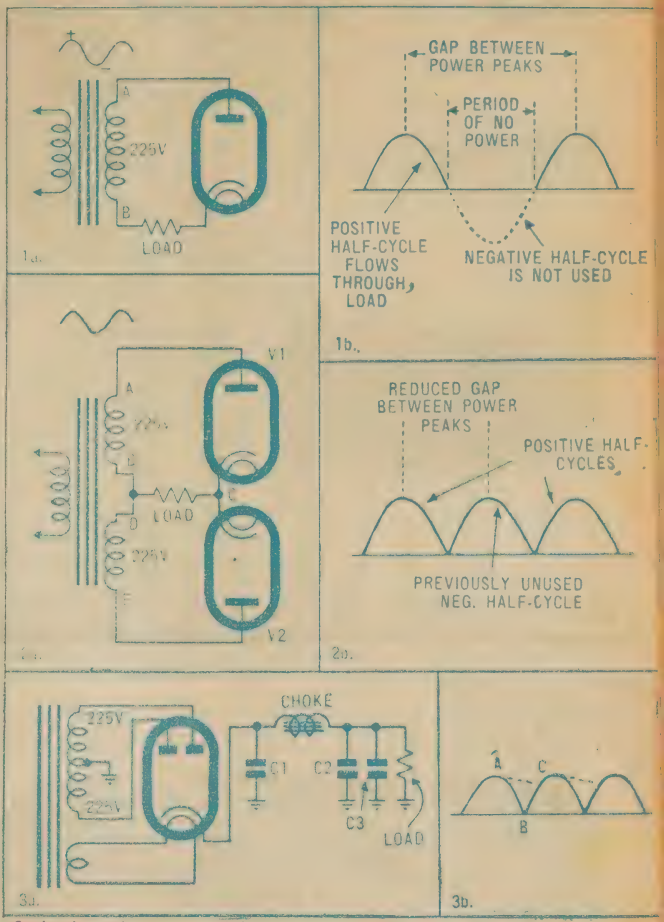
With rates of discharge which occur in the average receiver, however, the conditions will be very much as shown, which means that the output is still not steady enough to ensure hum-free operation. We pass on, therefore, to the next section, the choke, which contributes to the filtering by opposing any change in current flow through it. While the current is perfectly steady the choke opposes the flow only to the extent of its DC resistance. However, when the current tends to rise the expanding magnetic field opposes this by trying to force a flow in the opposite direction. When the current tends to fall, the collapsing magnetic field produces a current flow in the same direction, thus assisting to maintain a steady flow.

LOW CURRENT

Where the current flow is only a few milliamps the job of filtering is not so difficult, as the condensers are not discharged appreciably between peaks. In this case it is possible to obtain perfectly satisfactory filtering without the choke, its place being taken by a resistor. This scheme has been used in the present set, and the resistor also reduces the voltage to that required by this simple circuit.

The second filter condenser functions in much the same way as the first, although its job is much easier, as only a small amount of ripple remains to be filtered. However, it has another job to do, that of storing energy to meet the instantaneous demands made by the receiver. Although the average current drawn by a receiver may be quite steady it varies from instant to instant over a fairly wide range. This is mainly due to the requirements of the output valve, the plate current of which varies in accordance with the signals applied to the grid. In order that the plate voltage remain constant over this range the second condenser must store enough energy to supply

THESE DIAGRAMS ILLUSTRATE TEXT



Study these diagrams carefully as you read the text, and you should have no difficulty in understanding the power supply.

these requirements without showing appreciable discharge.

RF BYPASS

This condenser also has to provide a low impedance path for the signals passing through all the valves of the receiver, as the power supply or battery is the return path for these signals. If a high impedance occurs at this point voltages will appear across it and will in turn be applied to other stages of the receiver, causing unwanted coupling and probable instability.

The electrolytic condensers used in power supplies provide a lot of capacity in a small space and at a low cost, but they tend to develop a high impedance to radio frequencies quite early in life, and so it is usual to provide an extra condenser of the paper variety, shown as C3 in the diagram. This condenser does not have a high capacity compared with the electrolytics (about .5 mfd) but is much more efficient at RF.

A careful study of the above should give you a pretty thorough knowledge of power supplies and how they work, while comparing figure 3a with the receiver circuit diagram will give you some idea of typical values and show how the receiver itself replaces the load resistor which we have considered up till now.

The addition of the power supply to the receiver is not a difficult job and the wiring diagram should clear up any doubtful points. The socket for the rectifier valve is of the octal type, and when mounting this remember to fit a small tag strip under one of the mounting bolts.

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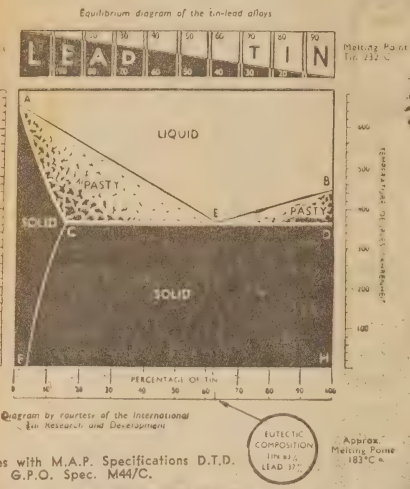
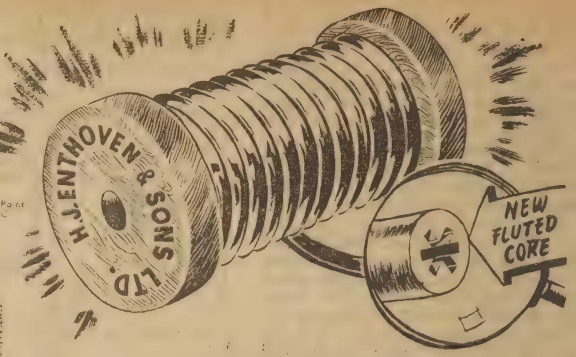


Diagram by courtesy of the International Tin Research and Development



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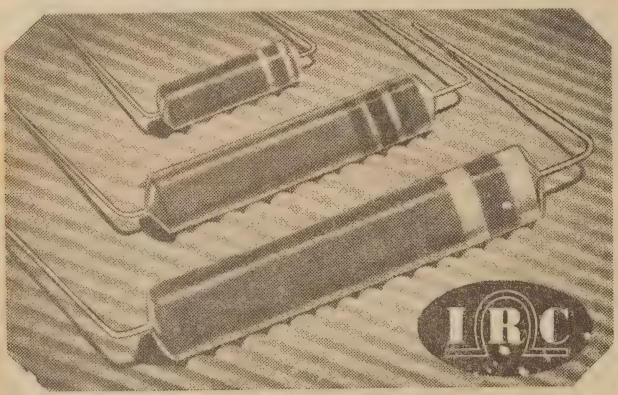

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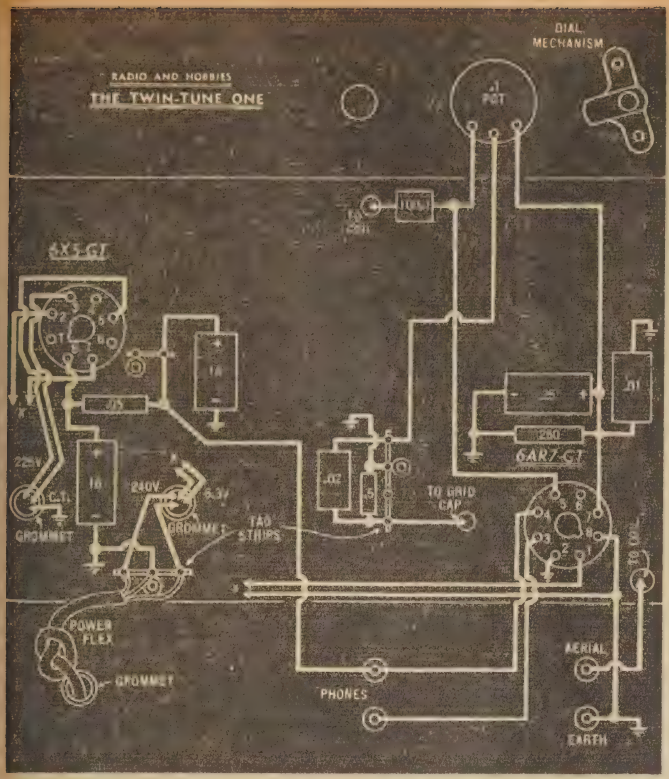

This wiring diagram shows all the additional components and wiring, and should be studied in conjuction with the circuit.

to the 6AR7 must now be connected to the rectifier filament pins as well, and probably the easiest way to do this is to transfer the two leads to the rectifier socket and then run a twisted pair from these pins to the 6AR7 socket.

The HT leads which were covered with tape for last month's version are now wired to the plate pins of the rectifier socket, while the centre tap connects to the chassis. The actual HT point will be the rectifier cathode, and between this point and earth we connect the first filter condenser. Being an electrolytic, we must observe the correct polarity, and the cathode will be positive and the chassis negative.

To this same point is connected a .05 meg resistor, and it will be most conveniently mounted between the socket pin and a terminal on the tag strip. To the tag strip terminal is connected the second filter condenser, once again having the negative side to the chassis. This terminal is also the point from which the completely filtered HT is made available to the set proper. At this stage the combination of current drain and filter resistance is such that the available HT is about 65 volts, which is quite sufficient for our needs at the moment.

We had hoped at this stage to give you a detailed explanation of the operation of a detector, but we have decided against it for two main reasons. First, to give the kind of explanation we would like calls for more space than we have available, and second, we feel that to include it and the power supply story in the one article is to risk mental indigestion. However, this and other subjects have been noted as warranting attention at a later date, possibly when this series is finished.

DETECTION

For the moment we will simply state that the process of detection is really identical with that of rectification, the only real difference being the frequency involved. Thus we find that all detectors, whether valve or crystal types, operate on the same principle, namely, that of offering more resistance to current flowing in one direction than the other. The detector circuit we are using this month works in exactly the same way as the germanium crystal, the main reason for the different method of wiring being that the cathode of the valve is common to both the diode and triode sections.

Incidentally, there is no need to regard the germanium crystal as a dead loss simply because we are discarding it at this stage. There are plenty of ways in which it can be used in modern receivers, while those who have followed this series from the start will be well on the way to possessing both a crystal set and a mantel set. The base board and

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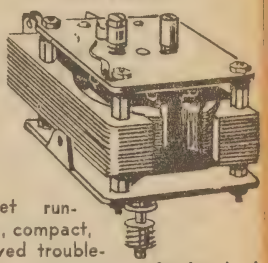

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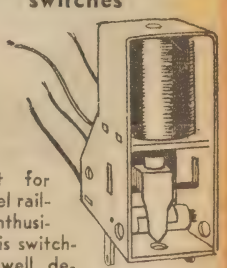

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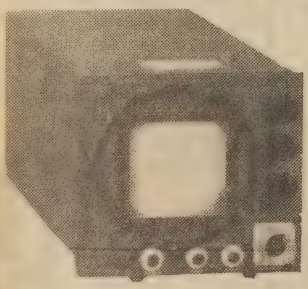

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panel which were discarded after lesson 1, the crystal we have just put aside, and the coils which will soon be replaced, provide the major components for a crystal set, and if you don't want them yourself there is no doubt a more junior member of the household who could use them.

The increased HT makes it necessary to reduce the bias resistor from 3000 ohms to 250 ohms, but otherwise the amplifier circuit remains unchanged. However, there are quite a number of changes in the detector circuit and it may be as well to detail some of these.

EXTRA CONDENSER

In addition to the electrolytic across the bias resistor we also have .01 mfd paper condenser, because the cathode of the valve is now part of the detector circuit and it is essential that RF signals be able to pass from here to the chassis without having to pass through the bias resistor. As we have already mentioned, electrolytics are not very efficient at this job, hence the paper variety.

Connections to the potentiometer have been changed, that which formally went to the chassis now connecting to the cathode, while the crystal end now goes to the diode. This end also connects to the coil tapping through a small mica condenser.

The grid of the valve is still connected to the moving arm of the pot, but instead of being a direct connection it is now made through a condenser, while a separate resistor completes the grid circuit to the chassis. A small tag strip is useful in mounting the coupling condenser and grid resistor, and the position for this may be seen in the wiring diagram.

The filament circuit as shown in the circuit diagram may puzzle some, as the filament of the 6AR7 appears to be incomplete. This is a convention you will find followed in most circuits today, it being considered that this part of the circuit is so simple that in most cases it need not be shown, while to include it would only make the circuit appear unduly complicated. Usually some identifying mark, such as an "x," is placed opposite the filament winding and the valve filaments which are to be connected.

Well, that's about all there is to tell about the Twin-Tune One; the few alterations and additions should not take very long, and you'll find that results are a marked improvement on last month's effort. In fact, for a set which is so small and so simple to operate they are quite surprising.

PARTS LIST

- 1 6X5 valve
- 1 Octal socket
- 2 16 mfd 525V electrolytic condensers
- 1 .05 meg 1 watt resistor
- 1 .5 meg, 1 or ½watt resistor
- 1 250 ohm, 1 watt resistor
- 1 .01 mfd 600V condenser
- 1 .02 mfd 600V condenser
- 1 100 pf mica condenser
- Tag strips, solder lugs, etc.

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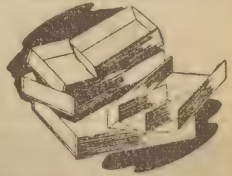

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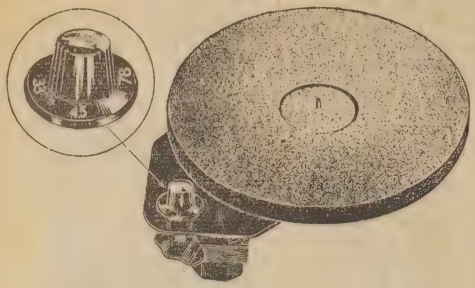

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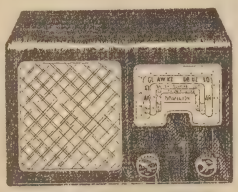

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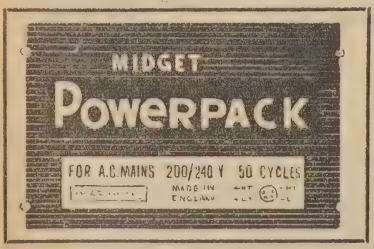

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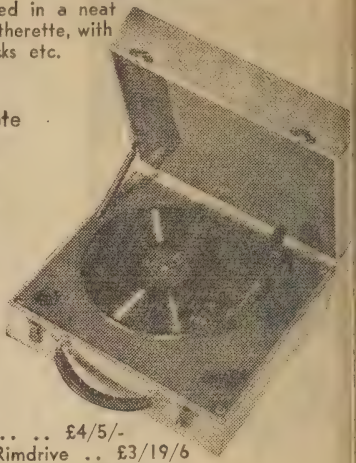

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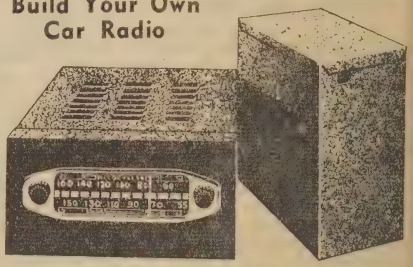

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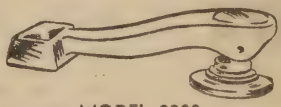

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AUDIO DISTORTION MEASUREMENTS

Part I of this series contained a discussion of the nature of audio frequency distortion and a survey of the methods employed in making quantitative distortion measurements on audio equipment. The present article details the design and construction of a simple and practical distortion analyser which is a very useful adjunct to any amplifier service shop or audio high fidelity experimenter's bench.

THE instrument is compact, easy to adjust and use, and costs little to ild. Yet the results obtained are ficiently accurate to permit aluation of the performance of ost audio equipment and observa- n of the results of even minor sign changes.

As was pointed out in Part 1, the mplest form of distortion meter ploys a null bridge to suppress fundamental test frequency be- amplified under test and a cuum tube voltmeter to read the plitude of any signals which ss unattenuated through the null dge.

If the signal input to the amplifier a pure sine wave of frequency ual to the null frequency of the dge, the only signals indicated by voltmeter will be the harmonics troduced by distortion in the plifier being tested.

HARMONIC PERCENTAGE

If the response of the voltmeter linear it is easy to express the al harmonic content thus indicat- as a percentage of the amplifier tput.

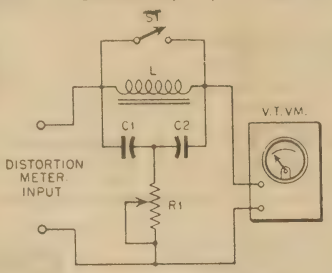
The major shortcoming of the null idge type of distortion meter, as it usually employed, lies in its in- ility to identify the order of the rmonic content indicated. It reads al percentage of distortion and us may only be classed as a dis- rtion meter.

To be considered a distortion alyser the instrument should be pable of identifying each harmonic mponent present and indicating eir relative amplitudes.

Commercial distortion analysers hich accomplish this are both com- icated and costly. However, a mple system is available which is ot appreciably more complicated han the common null bridge distortion meter, but is capable of considerably better results.

Its use is predicated upon the availability of a second audio oscillator.

The circuit of a typical null bridge distortion meter is shown in Fig. 1. The components L, C1, C2 and R1



BASIC DISTORTION METER
FIG.1

constitute the null bridge network which suppresses the frequency at which L and the series combination of C1 and C2 are resonant, as given by:

(1)

$$\text{Null frequency } (f) = \frac{1.414}{2\pi\sqrt{LC}} \text{ cycles per sec.}$$

Where: L is the choke inductance in henries
C = C1 = C2 is the capacitance of each unit in farads.

The circuit configuration will be recognised as the "bridge-T" type of network. The resistance (R1) is used to adjust the null reading to minimum.

If the circuit constants are chosen properly, and distributed capacitance is minimised, virtually zero transmission will occur at the null frequency. If the null circuit "Q" is high the null will be very sharp and nearby frequencies will be very slightly affected.

The voltmeter is used to measure both total amplifier output and harmonic output by shunting out the bridge circuit with the switch (S1) during the former measurement. A vacuum tube voltmeter may be employed or a simple crystal diode voltmeter may be used with only a slight sacrifice in accuracy.

To convert the distortion meter of Fig. 1 to a distortion analyser the modification shown in Fig. 2 is made. An audio transformer is added to permit the insertion of a sine wave signal from a second audio oscillator. This signal is used to identify individual harmonic components present in the bridge output by the beat method.

To accomplish this the second oscillator is swept through the frequency range containing the harmonics of the fundamental test signal. Fig. 3 is a block diagram of the complete test set-up.

Near the frequency of each harmonic present a "beat" will be observed in the distortion meter reading. The amplitudes of the beats are indicative of the relative magnitude of each harmonic component identified. Thus, a quantitative indication of harmonic content, as well as total harmonic percentage, is obtained.

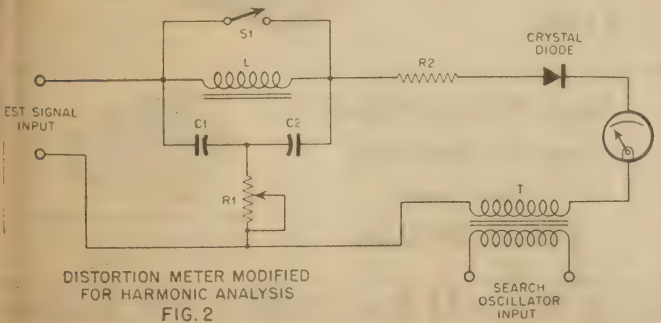
EXAMPLES

As an example, suppose that the test frequency is 400 cycles and the distortion meter indicates a total harmonic distortion of 10 pc before the introduction of the "search" oscillator.

If there is both second and third harmonic distortion an amplitude beat will be observed when the second oscillator is swept through 800 and 1200 cycles. If the second harmonic predominates the beat at 800 cycles will be greater than the one at 1200 cps in the same proportion. Knowing the total harmonic distortion it is easy to evaluate the percentage of each harmonic component.

The search oscillator frequency should be adjusted close enough to the harmonic frequency to give nearly zero beat, so that the meter needle can follow. The oscillator used for searching should be relatively free from harmonic output.

The practical circuit diagram of the distortion analyser is given in Fig. 4. Since no vacuum tubes or power sources are required for its operation, the unit may be assembled in very compact form.



DISTORTION METER MODIFIED FOR HARMONIC ANALYSIS
FIG. 2

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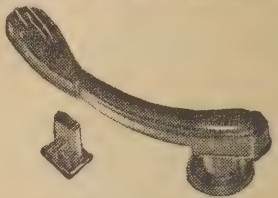

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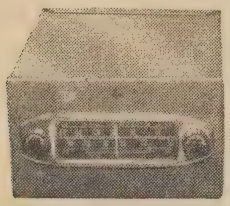

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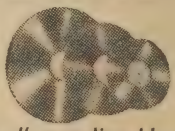

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The dimensions of this shelf and the approximate locations of the parts mounted on it are shown in Fig. 5. The suggested front panel lay-out is shown in Fig. 6.

To assure maximum versatility, three null bridge frequencies—400, 1000 and 5000 cycles—are provided. These frequencies are selected by substituting the proper capacitance values for C1 and C2. Capacitor switching is done with a two-circuit, three-position wafer switch.

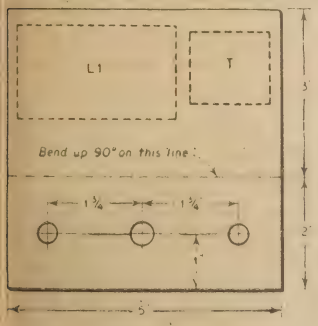
(2) $C1 = C2 = \frac{1}{158 f^2}$ farads (for 8 henry choke)

Where: f is the desired null frequency.

If additional or alternative test frequencies are required, the necessary capacitor values may be computed from:—

For most routine amplifier testing, the three frequencies for which values are given in Fig. 4 will be sufficient.

For effective fundamental frequency rejection with low harmonic frequency attenuation, the "Q" of the null bridge components must be high. Best quality components should



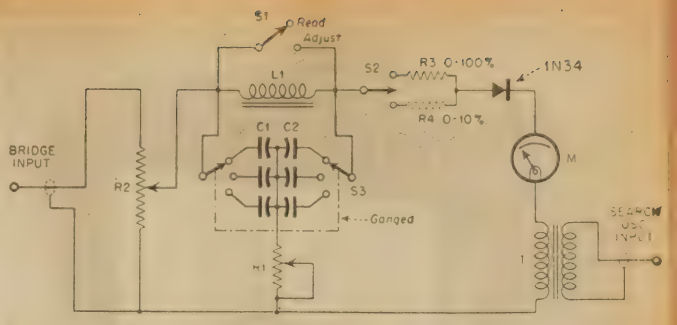
DETAILS OF SHELF
FIG. 5

be used for the resonant circuit comprising C1, C2 and L.

The choice of the choke is important since the resistance as well as the inductance of this unit is critical. The resistance of the choke will adversely affect the "Q" of the null circuit if too high.

Some selection of capacitors may be necessary to arrive at any given test frequency, although for most practical purposes it is not necessary to measure distortion at exactly the frequencies specified.

The null resistor (R1) is a variable 1-megohm potentiometer mounted on the front panel and provided



R1 - 1 megohm, carbon.
R2 - 1000 ohm, wire wound.
R3 - 30,000 ohms, ½ watt carbon.
R4 - 2000 ohms, ½ watt carbon. (Approx.)
S1, S2 - S.P.D.T. toggle switch. See text
S3 - 2 gang, 3 position wafer switch.

L1 - 8 hy. 150 ohm choke
T - See text M - 0-100 microamperes
CRYSTAL - 1N34 or equivalent
C1, C2 - 400 C.P.S. .04 μfd (Aerovox Type 489)
- 1000 C.P.S. .006 μfd (Aerovox Type 1089)
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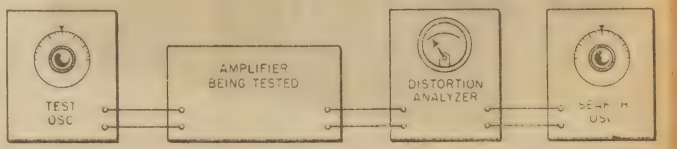
PRACTICAL DISTORTION ANALYZER
FIG. 4



TEST SET-UP FOR DISTORTION MEASUREMENTS
FIG. 3

with a small knob. This control is used to adjust the null response to minimum at each of the test frequencies. The setting of R1 usually remains fixed for any given frequency.

The crystal diode voltmeter uses a 1N34 or any of the germanium crystals as a rectifier. It gives a response that is approximately linear with input voltage if a high sensitivity meter is used.

A 0-100 microampere meter is ideal, since the scale calibration can be used to indicate distortion percentage directly. Otherwise, any meter requiring less than about 250 microamperes for full-scale deflection may be employed.

TWO RANGES

Above this current, the average crystal diode characteristic departs markedly from linearity.

Two meter ranges are provided to allow more accurate reading of distortion percentages. These ranges, 0-100 per cent and 0-10 per cent, are selected by switching meter multiplier resistors R3 and R4 by means of a toggle switch (S2).

The multiplier resistor for the 0-10 per cent scale is selected to give full-scale deflection at 1-10th the rms. input voltage required to give full-scale reading on the 0-100 per cent range.

The audio transformer (T) may be almost any unit of good quality which the experimenter might have available. The characteristics are not critical, since this transformer is used merely to introduce a small audio voltage from the search oscillator into the voltmeter circuit. A good 3:1 interstage audio transformer will usually be found satisfactory.

The audio input cable to the bridge circuit, as well as the external lead to the search oscillator, are run through holes in the left-hand side of the metal cabinet and wired permanently to the circuit.

These leads are of standard single-conductor shielded audio cable and are fitted with alligator clips at the input ends. The cabinet holes should be fitted with rubber grommets.

The use of the instrument is relatively simple. After the construction has been completed, the operation of the null bridge circuit is

(Continued on Page 89.)

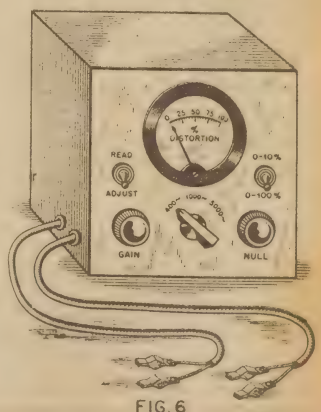


FIG. 6

Attenuator controls are at the bottom left, bandswitch next and then the function switch. "Pye" connectors provide RF outlets and phone jacks give access to the audio circuits.

A 7-BAND TEST OSCILLATOR

Designed as a companion instrument to the "Radio and Hobbies" frequency meter, this all-band modulated oscillator is ideal for use on the service bench or in the "Ham" shack. With proper attention to detail, it can be made to cover a range extending from about 80 Kc to over 100 Mc.

by W. N. Williams

BEING designed primarily for construction by amateurs or servicemen, we have made no special effort to standardise on layout or cabinet size. The instrument is too large to fit into our small instrument case and many, like ourselves, will have available oddment cases and panels which they will want to press into service.

With the electrical design already worked out, however, it should not be too difficult for the advanced constructor to attend to the mechanical side.

The original frequency meter is still in use at the writer's station and the basic design has proved very satisfactory in its many and varied roles.

LIMITATIONS

However, like most heterodyne frequency meters, it provides a profusion of harmonics on the higher frequency bands and confusion can arise if means are not available to identify them. A further difficulty is that the meter does not cover the intermediate frequency bands.

The present modulated oscillator was designed to fill the gap and was built to match physically the appearance of the frequency meter. The same type of case was used—from a disposals aircraft receiver—measuring approximately 11 x 10 x 7 inches overall. Chassis, panel, brackets, &c., were made up to suit, from 16-gauge aluminium.

In planning the instrument, we wanted to cover as wide a range of frequencies as possible, extending at least to the 50 Mc. amateur band. If still wider coverage could be obtained, so much the better, even though it was realised that special efforts might have to be made to keep the oscillator going beyond this under necessarily adverse conditions.

This intention automatically involved the construction of a switched band coil unit, designed to minimise stray circuit capacitance and the length of active oscillator leads.

It suggested also the use of Colpitts circuit, which gives lower values of tuning "C" and also obviates the need for tapped or multiple-wound coils. This latter point is particularly important for the home constructor.

THE VALVE

For the valve we chose one of the newer high-gain RF pentodes on the general assumption that it would have a better high frequency performance than the older and more bulky types. It was assumed also that the grid-screen structure would be used for the oscillator, leaving the plate for the RF output circuit.

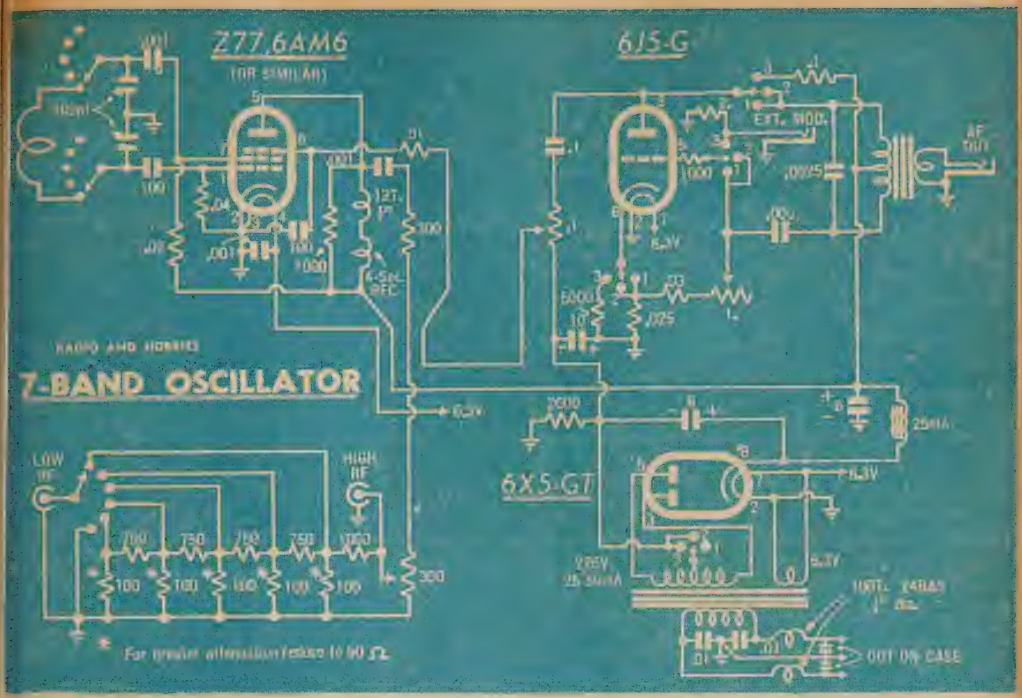
We originally had ideas about using one of the miniature converters but a brief test indicated that more could be expected of the high frequency pentode.

Thus it transpired that the final oscillator circuit was built around the Z77 (or 6AM6) pentode, which is now being imported. Its characteristics closely resemble those of the EF50 and RL7 and there is every chance that these would do much the same job, provided their additional bulk could be accommodated without lengthening any important leads.

Ordinary RF pentodes like the 6SJ7, &c., would work well enough up to 20 or 30 Mc. but could not be expected to oscillate much higher than that.

The circuit shows all necessary component values but it must be realised that these are much less important than good physical layout. On this will largely rest the ultimate frequency coverage, frequency stability and leakage from the completed instrument.

In the original instrument, the oscillator and coil assembly was built as a separate and self-contained



Layout of the circuit diagram emphasises the four distinct sections in the instrument. The four-pole three-position function switch can be labelled, "Standby — Modulated — Ext. Mod."

unit which attaches to the main chassis by means of a bakelite insulating flange. This makes it possible to use a single earth bond adjacent to the attenuator.

This unit was built up first, in our case, the various coils being adjusted and mounted in place, one by one, while operating from a temporary power supply. A grid-dip oscillator or a series of absorption wavemeters is an invaluable aid in this process, although the job can be done with nothing more than an all-wave receiver to assist.

Exact dimensions of the coil assembly will depend on the components and facilities available, as well as the space on the main chassis.

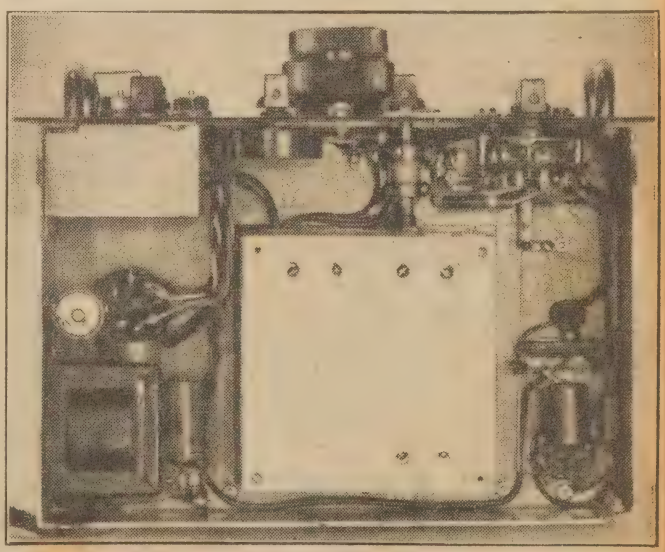
TUNING CONDENSER

The writer used a standard "H" gang which has a low minimum capacitance. A smaller gang would have allowed some reduction in the unit dimensions but if you select such a condenser, make sure that its minimum capacitance is down around the 8 or 9 pf. mark.

The coil unit was assembled, for the original instrument, on a bracket made by folding up a strip of 16-gauge aluminium, measuring 13½ x 4¼ inches. It was folded to give a "base" measuring 4½ x 4¼, two sides measuring 3¼ x 4¼ and two lips each about one inch wide.

We then cut out a rectangle of canvas bakelite large enough to overlap the base all round by about 3/8in. This was ultimately locked in place by the gang mounting bolts, the idea being that it would support and insulate the whole oscillator assembly when dropped through a hole in the main chassis.

Careful thought, plus some simple sketches, will be necessary to determine the relative positions of the



This underneath view shows the cover in place over the coil box, also the cover over the attenuator. Power supply components are grouped behind the attenuator, the audio components on the right-hand side of the chassis.

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ing spindle, the coil switch spindle id also the oscillator assembly as whole, in relation to the main iassis. Normally, the gang spindle ill have to fall at a convenient ight along the centre vertical line the panel, while the switch will so have to balance with the re-aining panel controls.

Plan the unit so that the con-enser will mount for preference rectly on the base, thus avoiding ie need for stand-off pillars and ng stator leads. Holes should be illed so that the two stator leads in run directly down through the iassis, being soldered, if necessary, the stator assembly, if that gives orter wiring than the regular lug.

Another hole should be drilled bring the earth lead from the ang wipers.

HORT LEADS

Position the oscillator valve so iat it just clears the condenser. miniature valve is a distinct help this connection, as a larger valve ould entail increased unit dimen-ons, unless paired with a smaller ang to compensate.

Underneath the unit, the switch ould ideally be placed so that it alls between the gang leads and ie valve socket, thus ensuring the hortest possible active paths.

We collected enough switch "hard-are" to locate the wafers about 1½ nches apart and in a central posi-ion. The switch clicker plate locks the front of the unit, while the ong assembly rods pass through and ock also to the rear plate, giving a ompletely rigid assembly.

Finally, the wafers were positioned keep the wiper lug toward the ase plate. This allows the leads rom the gang stators to be run irectly to the wiper lugs, the grid nd screen condensers bridging from he respective lugs to the valve ocket pins.

The earth wire from the rotor lates runs to a common earth point t one of the socket bolts, being ridged from there to the cathode eturn and the centre spigot.

COIL SWITCH

Regarding the choice of switch, you vill probably need to buy 11 or 12—osition wafers to give you enough ontacts. If possible get the wafers vhich have a shorting ring on the everse side, as this will short out nused coils and minimise risk of bsorption effects. If these are not rocurable, ordinary wafers can be sed but care will be necessary, as the original unit, to avoid cross oupling between the active and idle oils.

Trimmers can be regarded as an ptional feature, their main advan-age being the facility to correct any ossible drift off calibration at the igh frequency end. Being con-ected across half the winding only, he trimmers have only a minor effect n coverage and a good quality mica ype will be stable enough for most urposes.

Most commercial oscillators now use variable iron slugs as well to permit alignment to an existing dial plate but the same provision is not so important in a single instrument. There is no objection to providing slugs, however, apart from the mechanical complication.

Coming back to the trimmers, these were mounted on a prepared bake-ite strip by drilling three holes for each trimmer, passing the lugs down through the two outer holes and turning the ends over to lock the trimmer in place.

After checking for shorts—a very desirable procedure—the trimmer assemblies were mounted in place, four trimmers on one side and two on the other. Holes were provided in the assembly plate to give access to the screws.

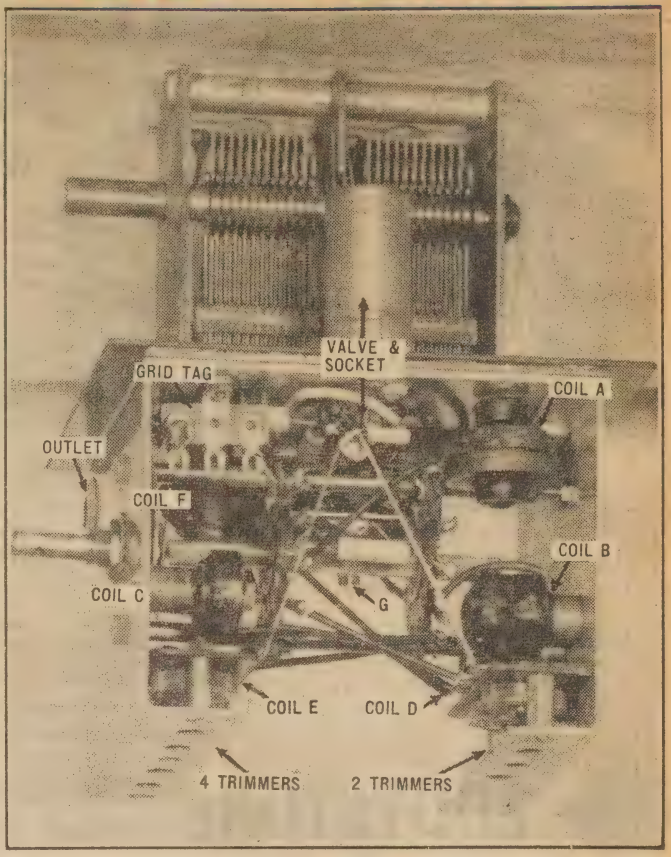
Coming to the coils, it is a fore-gone conclusion that hand-wound solenoids are out of the question for the lower frequency bands. For the amateur constructor, the best procedure is to raid "junk" counters in search of discarded coils and IF transformers—particularly the latter—and to use the ready-wound honey-comb windings.

With a Colpitts circuit, as specified, no taps are required on the coils and it is an easy matter to solder the two ends to the switch and note the frequency of resonance, either by means of a grid-dip oscillator or by tuning the signal on a receiver.

Turns can be removed and the desired coverage obtained by trial-and-error.

As each coil is completed, it can be provided with a suitable mounting, sealed up with paraffin wax and bolted into place. Arrange matters so that the highest frequency band will have its coil attaching to the switch points adjacent to the wiper lugs. This will give minimum path length in the switch on this critical band.

KEY TO MAKING COIL ASSEMBLY



Heart of the instrument is this coil box and oscillator unit. Note how coils are dispersed to prevent inter-coupling effects. With care, fundamental output can be obtained to just beyond 100 Mc. Specialised construction might carry the limit even higher.

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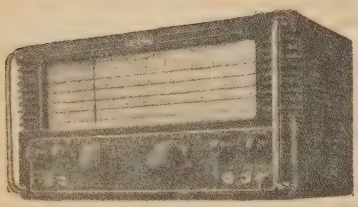

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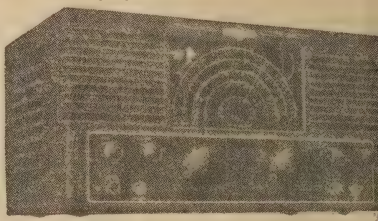

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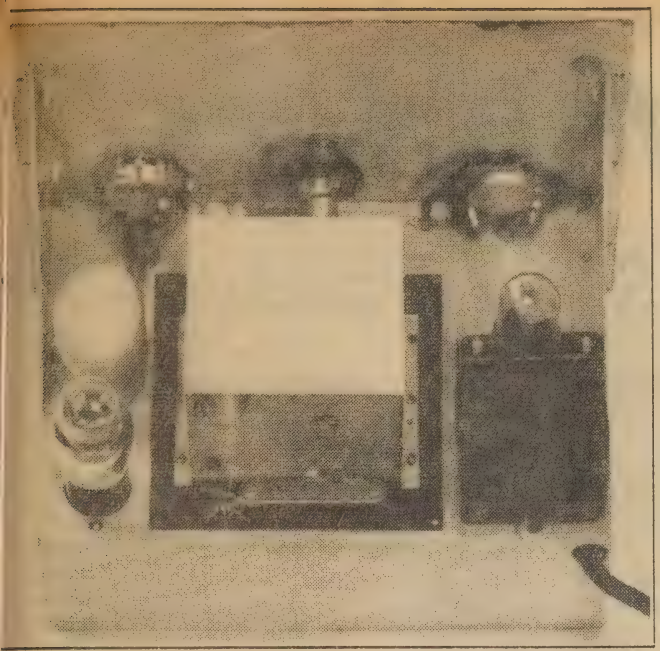

Rear view of the chassis. The pot. just above the RF output sockets controls modulation depth while its counterpart on the opposite side is for tone variation. Tone can be used for simple audio tests and synchronised with 50-cycle CRO sweep.

When wiring in the litz coils be ure to make contact with all the trands.

A good technique is to hold the oil in one hand and grip the free nd of the wire in the teeth. With he free hand, apply a small amount f flux to the wire and run the hot on tip up and down until the silk nd enamel burn off. The solder vill then take easily.

HANDLING LEADS

Be careful with leads also, as too nuch handling can subsequently reak individual strands. A good lan is to slip some 1-mil. spaghetti ubing over the ready-tinned lead nd then anchor the tubing to the oil with a blob of wax.

It was assumed at the outset that he broadcast band would be covered vith one sweep of the dial, for the ake of convenience.

Knowing that the inductance re- uired would fall somewhere be- ween that of a standard broadcast oil and a 455 Kc IF winding, we tripped a discarded IF transformer f the type which has a variable lug as well as two iron cups sur- ounding the winding.

The former was cut in halves and he iron core and cups removed. Next, the iron tip was held inside he cardboard former to soften the vax and the winding slid along to he end of the tube.

To provide a mounting, a piece of vooden dowel was forced into the ube, a hole having first been drilled n the wood to receive a brass mount- ng bolt. The presence of the bolt nside the coil has a slight effect on he inductance and it is wise to make any adjustments with the bolt in place.

On test, it was found that the winding, without any iron slug or cups tuned from 1850 to 580 Kc. By adding one cup only around the winding and sealing it into place, the tuning was shifted to the range 1700-540 Kc.

If an iron-clad winding is not available a standard winding could be used, in which case you may have to strip off something like 40 turns, the exact figure being determined by tuning the signal on a broadcast receiver. For identification, we designated the broadcast band as "Band C".

To cover the intermediate frequencies (Band B), we took an ordinary 455 Kc IF transformer, removed the slug assemblies and using the hot-iron-tip technique, pushed the two windings hard together. The windings were then connected in series by joining the outside of one to the inside of the other. When ultimately waxed up and mounted in place, Band B was found to cover 700-200 Kc.

COVERAGE

If this amount of overlap is reckoned to be excessive at the high frequency end, it could be reduced and some band spreading obtained at the same time by shunting the coil with enough fixed capacitance to drop the high frequency limit to about 600 Kc. The same procedure can be adopted on other bands, where necessary.

For the lowest frequency band, the problem is to locate an inductor which will be small, yet have enough inductance to resonate at a very low

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KC5	OSC-ECH33, X61M, 1R5	TECHNIQUE DEVELOPED BY KINGSLEY PRODUCES
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KC7	OSC-6A8G, 1C7, 1A7GT	
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equency with the available 200 pf ning capacitance. We tried a variety odd chokes and windings, most of em falling short of the 100 Kc tar- t.

Ultimately we came across an im- rted 13 millihenry Eddystone oke, wound in two sections. Actu- ly a multi-section inductor is not eal in an oscillator circuit and to t the grid current as well as change e range slightly, we added a 50 pf ndenser between the screen side of e winding and earth. The final verage extended from about 270 85 Kc.

SING HARMONICS

The harmonics from these low fre- ency bands will serve to identify e fundamental signal frequency. ost receivers have broadcast fre- ency calibrations on the dial and is not a difficult matter to check e alignment so that they are reason- bly accurate.

Couple the oscillator so that the rmonics are moderately strong in e receiver, then tune across the ial. It may then be found that a rmonic is heard every 90 Kc, which clear indication that 90 Kc is the ndamental signal frequency.

Having established this point, you an identify the harmonic at 900 Kc s being the tenth and it can then e followed down to give a calibration 160 (1600/10) Kc.

By identifying other harmonics, the rocedure can be followed for all the wer frequency bands and the cali- ration will be as accurate as you an make the calibration of the roadcast dial.

The same technique will serve also, s an emergency measure, to check equencies which may fall between e broadcast and short-wave bands f the ordinary dual-wave receiver. ost likely use for frequencies im- ediately above the broadcast band s to align IF channels around the Mc. mark.

To cover this band we simply kept n pulling turns off an IF trans- ormer winding until the coverage verlapped the high frequency end f the broadcast band. The resulting Band D" then covered from 4.0 to .4 Mc.

H.F. BANDS

For band E, we provided a hand- wound solenoid, comprising 31 turns f 28 B & S enamel, close wound on a 1-inch former. Coverage of this coil proved to be 3.5 to 12 Mc.

For band F, the coil comprised 11 turns of 18 B & S enamel close wound on a ½-inch former. Coverage for this band was 9.5 to 33 Mc.

Trimmers are used on six of these bands, being connected between earth and the grid side of each winding.

How far beyond 33 Mc your oscil- lator will go depends mainly on the physical layout of your unit and the capabilities of the oscillator valve. Some experimenting may be neces- sary to produce reliable operation to the 100 Mc limit.

The operating potentials on the valve have an important bearing on the performance in this region, as also do stray resonance effects in the output coupling network. Strange

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D.C. Radio Filtered.
Ideal for Battery Sets, Portable Radios, etc.
NEW CONDITION.

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12-volt, 5 amp 39/6
12-volt, 1 amp 25/-
Packing and postage extra.

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Type TR1143 — 17 valves — Range 100-130 m/cs £15
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Type 108 — 7 valves — Range 6-9 m/cs £12/10/-

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A.W.A. Teleradio — 5 valves — Range 2-10 m/cs £25
Type TA12 — 7 valves — Range 1-8 m/cs £14/10/-
Type AT5 — 5 valves — Range 9.14-20 m/cs £10/10/-

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RA10FA — Less valves — Range 150-400 k/cs-2-10 m/cs £11/10/-
ASV type AR301 — 9 valves — Range 160-190 m/cs £8/15/-
F.M. Receiver—10 valves—Range 27-40 m/cs £12/10/-
Type CRV-24 volt — 6 valves — Range 195-9050 k/cs £25

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Ideal voltage control for aircraft and home lighting generators, etc.
PRICE, each **50/-**
Packing and postage, N.S.W., 2/3; Qld., Vic., Tas., 3/3; S.A., W.A., N.T., 4/6.

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12-volt 500-watt (F.O.R.) Each **£9/10/-**
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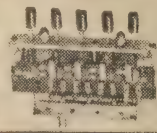
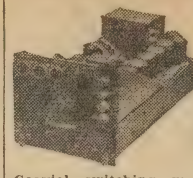
Field type, complete with magneto, bells and sound-powered push-to-talk handset (no batteries required). Mounted in metal carrying case with strap. Size 10 x 5¼ x 4¼ inches. Brand new in original sealed cartons. Weight packed, 12lb.
PRICE, F.O.R. **£4/7/6**

PUSH-BUTTON SWITCHES

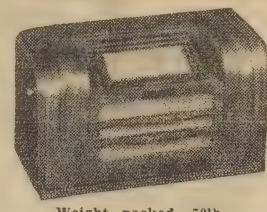


5-pole each 2 pair of contacts. Made in USA. Ideal for receivers, multimeters, etc.
Price, Each .. **12/6**
Packing & Postage, N.S.W., 9d; Interstate, 1/6.

U.H.F. A.S.V. RECEIVERS AR301



Complete with 11 valves: 2—R.F. stages, 954 acorns; mixer and oscillator, 2—955 acorns; 30 mcs. I.F. channel, 4 — 6AC7's, detector 6H6 cathode follower 6AC7, rectifier 5V4G
Coaxial switching motor, 2-volt D.C.
Frequency range, 160-190 mcs.
Weight unpacked, 30lb.
Suitable with minor alterations for conversion to F.M. Band (58-108 mcs). Television Band (175-200 mcs), 144 to 288 mcs. amateur bands.
Complete with valves above in vented metal case, size, 7½ x 8½ x 18 inches.
Price, F.O.R. **£8/15/-**



Weight packed, 70lb.
BRAND NEW

BREVILLE 5-VALVE DUAL WAVE RECEIVER

With 5 spare valves and vibrator cartridge FREE.

6 volt vibrator operated. Attractive walnut cabinet. Brand new, in original packing case. Ex-Amenities, 12 months written guarantee. Large, straight line tuning dial. Instruction sheet supplied with each model, 7-inch permagnetic speaker. Local, Interstate and overseas reception.

USUALLY PRICED AT £45/17/6

OUR PRICE, F.O.R. £29/10/-

DISPOSAL VALVES, TESTED

1K7G	8/6	956	12/6
6AC7	14/-	9001	10/-
6AG7	20/-	12A6	10/-
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7193	8/6	EA50	7/6
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955	12/6	VT90	
		Micropup	10/-

NEW VALVES

6C8G	14/-	837	25/-
6H6	10/-	879/2X2	15/-
6J5G	11/-	1294	11/6
6SQ7	12/6	1293	11/6
6X5GT	12/6	VR34/EB34	5/-
7A6	10/-	VR65A	5/-
7C7	11/6		
83V	11/-		

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Ideal for A.C. Meters and Multimeters, etc.
Price, each **15/-**
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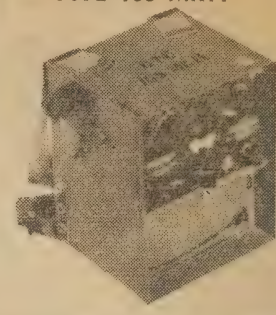

Frequency Range, 6-9 m/cs. Complete with Valves, Microphone and Headphones. Self contained Dry Battery Supply. Ideal for communication between small ships, etc.
PRICE, less batteries .. **£12/10/-**
F.O.R.

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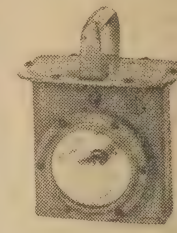
ELECTRIC LANTERNS



Ideal for country homes and for use during blackouts. Operates from two No. 6 Dry Cells. Batteries should last in excess of two years with normal use.
Price complete with bulb—less Batteries . . . **25/-**
Packing and postage, NSW, 3/-; interstate, 5/6.

4W FLUORESCENT LAMPS

Colour: Blue. Length, 5½ inches. Ideal R.F. Indicators.
PRICE, Each **2/6**
Per Dozen **25/-**
Packing and Postage, 6d each.

METERS

0-10 mA., D.C. 2-inch round flush, new	22/6
0-30 mA., D.C., 3-inch round flush	25/-
0-30 volt D.C., 3-inch round flush, with datum indicator	30/-
0-300 mA., thermocouple. New	15/-
0-3 Amp., R.F. Thermocouple. New Imported 2" square flush	17/6
0-4 Amp., R.F., thermocouple. New Imported 2" square flush	17/6
20 mA., D.C., 300 amp. scale 3in. round flush	25/-
20 volt D.C., 2in. square flush, imported. New	20/-
40 volt D.C., 2in. square flush, imported. New	20/-
50 Amp., D.C., 2in. round flush imported. New	30/-
0-500 mA., R.F. Meters. 2in. flush	17/6
20 volt and 200 volt D.C. 2in. round dual reading with leads New	20/-

Packing and Postage, 1/6 each.

Please add exchange to all cheques. Make money orders and postal notes payable to Lewisham. Sorry, no C.O.D.

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grid current dips can often be traced to this part of the circuit.

Another procedure which may help in a stubborn case is to connect two midget capacitors, about 10 pf each, from grid to cathode and from screen to cathode right on the valve socket. These establish more positively the tapping on the tuned circuit and may assist where it is operating under adverse or ill-balanced conditions.

We were able to sustain oscillation to just beyond 100 Mc with a 2-turn coil wound from 18 gauge tinned copper, round a pencil. This was strung directly between the appropriate switch contacts.

Grid current dropped as the condenser was brought into mesh, the useful coverage with this tiny coil being limited from about 45 to 100 Mc. An additional switch position would have been necessary to fill the gap, the coverage extending upwards from about 30 Mc.

100 Mc COIL

We compromised, in the original instrument, by providing a 4-turn coil for band "G", wound to a 3/8" diameter and with 16 gauge enamel. This was strung, as before, directly between the switch contacts and gave a coverage from about 25 to just on 90 Mc. A strong second harmonic is available for the 144 Mc amateur band, which was the highest frequency actually checked.

This small compromise in high frequency coverage gives a convenient band arrangement and the larger coil produces reliable oscillation over the whole band. It would not be difficult, if you so desire, to wire in a smaller coil in the next position to cover the extra few Megacycles with the condenser in the near-open position.

To facilitate a check of grid current on all bands, the oscillator grid resistor was terminated at a tag strip, as shown in the photograph.

Another 5-position tag strip on the other side of the unit provides a connection for the outgoing leads, as indicated in the circuit diagram. All these leads pass through a single outlet, together with the earth bonding strap. The same tag strip provides convenient anchor points for the RF chokes in the oscillator plate lead.

CHOKE DAMPING

It is essential to connect a damping resistor, as shown, across the chokes to prevent resonance effects and absorption from the oscillator. The isolating resistor minimises the effect of attenuator adjustment on the plate circuit.

For the variable output control, the potentiometer should ideally be non-inductive and a carbon type is a good choice in this regard. However, many ordinary carbon pots do not reduce to zero ohms and this point should be checked. A good wire wound pot will overcome this difficulty and work well up to broadcast frequencies. Beyond that, its behavior may be open to query by reason of winding inductance.

For the low output circuit, the attenuator switch should ideally be mounted in a box with radial vanes to shield the individual resistors.

(Continued on Page 95)

A SINGLE cone medium heavy duty reproducer with an outstanding smoothness in response and performance. The magnet assembly using anisotropic material provides a total flux of 158,000 maxwells on a 1¾" pole, the back centring device being a dustproof linen disc with concentric corrugations. Functional in design and of robust precision construction, this 12" unit meets the most modern needs in the field of Public Address installations, small cinemas, high power radiogramophones, etc.

Overall Diameter .. 12 5/16"—31.3 cms.
Overall Depth .. .. 6 15/16"—76 cms.
Voice Coil Diameter .. 1¾" — 4.4 cms.
Fundamental Resonance .. .. 55 c.p.s.
Voice Coil Impedance .. .. 15 ohms
Power Rating .. .. 15 watts peak A.C.
Flux Density .. .. 14,000 guass
Total Flux .. .. 158,000 maxwells
Nett Weight 12lbs 13 ozs. (5810 grammes)
Finish .. .. .. Grey Rivelling Enamel

UNITED RADIO DISTRIBUTORS PTY. LTD.

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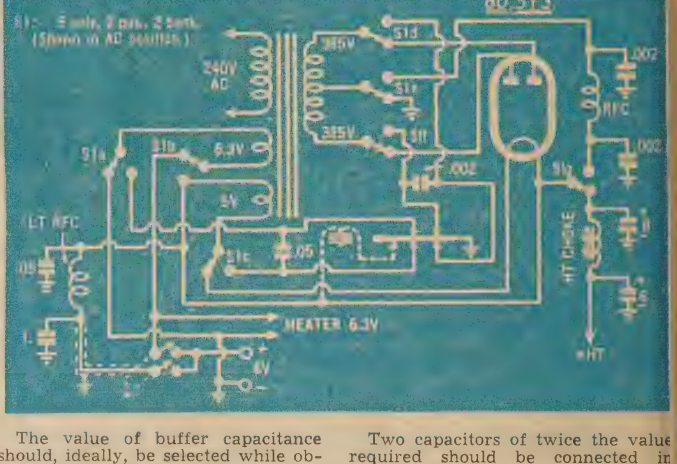
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

DUAL POWER SUPPLY USES STANDARD TRANSFORMERS

There is always a demand for a power supply which will operate from AC mains or from an accumulator. A Melbourne reader sends along this design which uses a standard power transformer.



OUR contributor is Mr. A. H. Dear of 16 Wellington St., Kew, E.4, Melbourne, Victoria. It appears that the idea was born at a time when Mr. Dear was unable to obtain a special transformer.

The 385 volt transformer could well be replaced by one rated at 285 volts a side to keep the HT output voltage down to a reasonable figure. Actually, the supply is best used only with sets employing permagnetic type of speakers to avoid wasteful loss of power across a loudspeaker field coil.

With the 285 volt a side transformer, the higher DC output from AC operation can be reduced to between 230 and 250 volts simply by inserting a suitable value of resistance between the rectifier filament and the associated switch section which connects to the filter network.

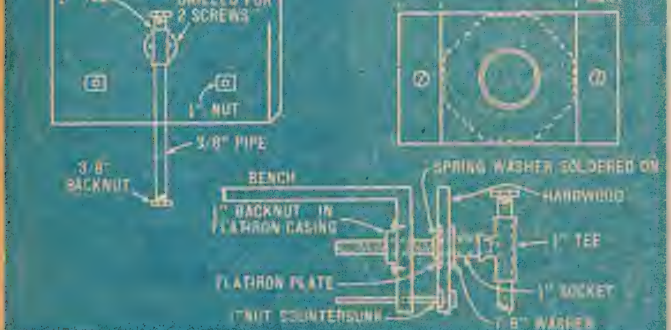
The value of buffer capacitance should, ideally, be selected while observing the secondary wave-form on an oscilloscope in an effort to reduce any high-amplitude transients. As an alternative approach, the correct buffer value will be found to give minimum current drain from the accumulator.

Two capacitors of twice the value required should be connected in series across the secondary winding to avoid possible voltage breakdown of a single unit.

The degree of filtering and shielding of the accumulator leads will depend upon individual circumstances.

HANDY BENCH VISE MADE FROM PIPE FITTINGS

Here is an idea sent in by Mr. R. J. Thomson, a reader from Burra North, South Australia. The general simplicity of construction should appeal to any handyman who needs a large vise in the home workshop, particularly for woodwork projects.



GAUGING from the size of the piping used, this vise is not intended for heavy work. Nevertheless, its uses are many.

Our contributor suggests that the cutting and threading of the bar iron can be arranged at any blacksmith shop or at some garages while the threading of the piping is a job which most plumbers will do for a small consideration.

The sketches are self-explanatory and the following list will assist in the gathering of the required "bits and pieces":—

A piece of 6½" by 1½" hardwood 12" long, 12" of ½" water pipe with 2" of thread on one end and 7½" on the other, 12" of 3-8" gas pipe with short thread each end, 2 pieces ½" bar iron 10½" long with 2" thread on one end, ½" socket, ½" tee, ½" backnut, 2 3-8" backnuts, 4 ½" nuts, 1 7-8" washer, large spring washer, 4 screws ¾" by 5 gauge, 2 screws 1" by 9 gauge, a piece of 26 gauge flat iron.

TRADE REVIEWS AND RELEASES

NEW LINE OF CONDENSERS

A NEW type of capacitor for high frequency equipment, where fficient by-passing is needed, has ıst been introduced.

It is the Hi-K Tubular Ceramic—n extremely miniature type, released y the United Capacitor Co. Pty. td.

The capacitor uses the new Unila-or K.3000 Dielectric, which, for the rst time, combines a very high ielectric constant (3000) with a high ısulation resistance at all working emperatures.

Stringent tests at high voltages nd elevated temperatures have been uccessfully passed by this new UCC elease.

Ideal for use in miniaturised equip-ent, UCC Hi-K Miniature Tubulars an be used to replace mica and paper ielectric capacitors. Their low in-uctance makes them extremely pplicable for HF applications and n filtering LT and HT Feeds in tele-ision and frequency modulation re-eivers, wide range IF amplifiers, re-uction of vibrator hash in auto sets, tc.

Those interested can obtain UCC Ii-k Tubular Ceramics from their ormal supplier. Interesting techni-al literature is available to Radio nd Hobbies readers on written pplication to the United Capacitor o. Pty. Ltd., 433 Punchbowl Road, nfield, NSW.

TECHNICAL BOOK REVIEW

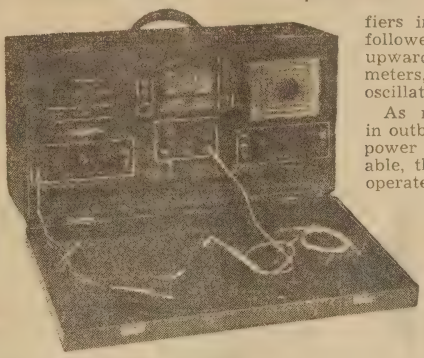
HOW To Build 78 Radio And Tele-vision Sets, by the Popular Science Publishing Co., New York. Hard cover, 256 pages, Australian price, 19/6 (approx.), plus postage /-.

This book covers almost every as-pect of radio set construction, com-mencing with hints on buying parts nd proceeding through crystal sets, TRF receivers, intercoms, short-wave and communication sets, to the assembly of a television kit. There s also a large amount of space de-voted to hints and tips as well as ome elementary theory.

The last section of the book con-ains several articles on FM and elevision aerials, including details of how to install and adjust. The book is very well illustrated and pre-sented, and will form a useful addi-tion to any beginner's library.

PRACTICAL RADIO COURSE

Representing a new step in basic radio training, the Australian Radio College have introduced a new practical radio course, in which the student learns largely by using radio components and conducting experiments.



TO avoid wastage of components, the course has been carefully planned so that the components are ultimately assembled into a complete radio test panel suitable for service work.

The panel comprises a multimeter which is constructed at an early stage and is used for testing other experimental units, a modulated oscillator and a signal tracer.

The parts for the test panel are sorted into nine separate kits and issued in a sequence which enables hundreds of interesting practical experiments to be performed. To mention just a few of the units constructed, there are receivers of 2, 3, 4 and 5 valves, a variety of amplifiers including push-pull, cathode, follower and grounded grid types, upwards of a dozen vacuum voltmeters, electronic capacity meters, oscillators, &c.

As many students are situated in outback areas or overseas, where power mains are not always available, the equipment is designed to operate from batteries which are included in the kits but, where required, an AC power unit can be substituted for the batteries.

On completion of the various experiments the parts are assembled on to the main panel provided, to form a complete kit of service instruments comprising a multimeter, modulated oscillator and signal tracer which is really professional in appearance and performance and which costs far less than equivalent commercial instruments.

The Practical Instruction Course provides an opportunity for students to gain practical experience in keeping with their theoretical studies and it is also available to servicemen and hobbyists who already have some knowledge of fundamentals and wish to purchase the series of kits only.

The kits are absolutely complete and include all valves and batteries.

A fully descriptive folder is available from the Australian Radio College, 206 Broadway, Sydney.

BYER TO MAKE MAGNECORDER

Byer Industries Pty. Ltd., of 8 Dorcas St., South Melbourne, have been granted the exclusive manufacturing rights of the American "Magnecorder" for the sterling market. The new product will soon be available alongside the company's already familiar BRS disc recording products.

IT has been reported that the Magnecorder, which is in the professional class of tape recording equipment, is used more extensively in the United States than any other recorder of its type and promises to prove extremely popular with Australian radio and electrical engineers.

It is understood that the first batch is already off the assembly line and, for the present, manufacture will be concentrated around the JA series, a twin unit, dual purpose combination.

The amplifier unit and tape drive mechanism are normally contained in separate carrying cases for portability, but may be extracted quickly and easily from their cases for rack mounting in studio or laboratory.

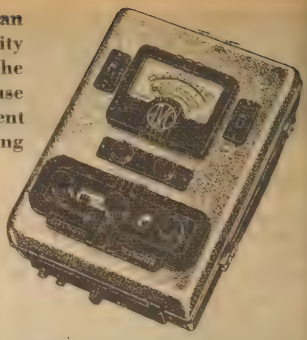
A feature of the Magnecorder is high quality combined with portability and adaptability.

A range of multi-channel mixer units is in course of production to enable two or more tape drive mechanisms to be coupled to a single amplifier for continuous program recording.

We have received descriptive literature from the manufacturers, who, we understand, will be pleased to forward details to those interested.

The "AVO" ELECTRONIC TESTMETER

Developed to meet the demand for an instrument of laboratory sensitivity built in a robust and portable form, the AVO Electronic Testmeter is for use where it is imperative that the instrument should present a negligible loading factor upon the circuit under test.



AVO

Precision ELECTRICAL TESTING INSTRUMENTS

The instrument gives 56 ranges of readings as follows:— *D.C. VOLTS:* 2.5 mV. to 10,000 V. • *D.C. CURRENT:* 0.25 μA. to 1 Amp. • *A.C. VOLTS:* 0.1 V. to 2,500 V. R.M.S. up to 2 Mc/s. With diode probe external 0.1 V. to 250 V. R.M.S. usable to 200 Mc/s. • *A.C. OUTPUT POWER:* 5 mW. to 5 W. • *DECIBELS:* —10 db. to + 20 db. • *CAPACITY:* .001 μF. to 50 μF. • *INSULATION:* 0.1 megohms to 1,000 megohms.

The thermionic circuit gives delicate galvanometer sensitivity to a robust moving coil movement. The instrument is quickly set up by a main Range Selector switch and two subsidiary multiplier switches.

The instrument operates on A.C. mains 100-130 V. and 200-260 V., 50-60 c/s.
SIZE: 12½" x 9" x 5½".
WEIGHT: 12½ lbs.

★

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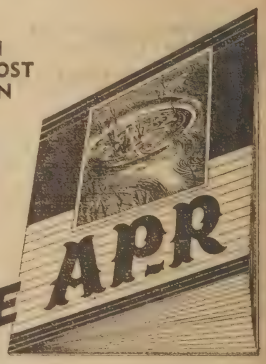

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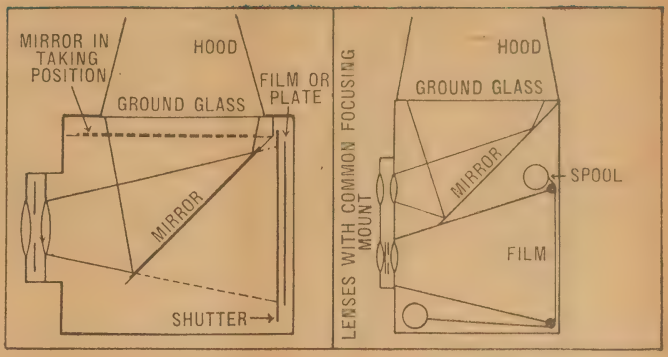
HELPING TO CHOOSE YOUR CAMERA



The basic principle of the reflex camera is shown in the drawing at the left. The dotted lines show the path of the light rays when taking the picture. The twin reflex on the right, uses a similar principle, but with separate lenses for taking and focusing.

Thinking of buying a camera? This article is intended to introduce the various types, so that the beginner will be better equipped to study the market and make a wise choice.

by Philip Watson

O many, who are perhaps con- sidering the purchase of their st "good" camera, the array of pes, sizes and prices is somewhat ewildering. The question is often ked, "Which is the best camera?" again, "Is it necessary to pay l that money for a camera, and ill the results be so much better an one gets with a box camera?" It must be admitted that some of e present-day prices are rather ggering to say the least and quite t of the range of the average nateur. One would-be purchaser, ticing an elaborate 35 mm model iced at something over £150, was ompted to enquire sarcastically if e price included a supply of film r life!

UR PURPOSE

We have therefore prepared this ticle to give you some idea of nat makes a camera expensive, or nat makes one better than another, that you may be in a position judge for yourself which type best suited to your particular eds.

The basic requirements of a mera are: A light-tight container to ld the sensitive film, a lens to flect the image onto the film, and shutter to control the time this age is allowed to act on the film. addition, even the simplest box mera has provision to wind a esh length of film into the picture- king position, as well as a view- der to tell the operator just what rt of a scene is being taken.

As we consider the more expen- e types we find various improve- ents, partly directed at the lens d shutter, and also at the ease of rking.

Lens improvements take the form both improved definition and ger sizes—and a large-size, good- ality lens can be quite an expen- e item on its own. The need for od definition is obvious, but the estion of size may call for some planation. The larger the lens, iative to the area it has to cover, e more light it will pass and the re chance there is of obtaining picture under poor lighting condi- ns.

CCURATE FOCUS

However, there is a catch to this the larger lens needs to be very curately focused and a lot of the mplications of many cameras is e to the elaborate means adopted ensure accurate focus. Also, a ge lens will often admit far more ht than is required and means st be provided to vary this to t prevailing conditions.

Another necessity, where pictures e to be taken under a wide range conditions, is a large selection of tter speeds. The mechanism re- ired to achieve this can be ex- tremely intricate, the tiny gears, pawls and levers being akin to those of a fine watch. Quite obviously, devices like this cost money, so that the price of a good camera is further increased.

The point about all these improvements is that they are directed not only at producing pictures which have high definition, but also at making it possible to take pictures over a wide range of conditions, both of lighting and subject. Most of the better quality medium-priced cameras are able to work under conditions which would be quite hopeless with a box camera, so that the accusation often levelled at the expensive camera that it takes pictures very little better than a box camera, is hardly justified.

THE RIGHT JOB

Many people buy an expensive camera on the assumption that, because it is expensive, they will automatically be assured of good pictures. Usually they are hopelessly disappointed, because nothing could be further from the truth. The more expensive camera has to be accurately adjusted to suit the prevailing conditions, and is really harder to use than the cheap one for ordinary casual outdoor shots.

In selecting a camera it is important to know just what may or may not be expected of a particular type and whether the lens size and shutter speeds are adequate for the owner's needs. Also, it is important that the owner know how to operate it correctly, or at least is willing to learn.

In order then that you may be able to compare the various types, we have divided them into four general groups, endeavoring to point out the important features of each. In the interests of completeness, we are including the box camera, as even in this field there are quite a few interesting points worth bearing in mind.

BOX CAMERAS

The box camera is by far the most popular type, mainly on account of its low cost but also to some extent because of its simplicity. In most types there is only one shutter speed, usually in the order of 1/25 of a second. The lens is the simplest possible type, often called a meniscus. The definition from this is good enough for contact prints, but any attempt at enlargement usually gives disappointing results.

Some models have a "time" setting for the shutter as well as the automatic 1/25. This is a very useful feature as it enables the shutter to be held open for as long as may be required, and makes possible pictures under what would be otherwise hopeless conditions.

LIGHT STOPS

Another useful feature, which unfortunately appears to have been dropped in more recent models was the provision of stops to control the light through the lens. The arrangement was quite simple, consisting

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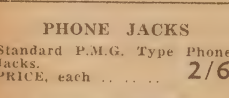

PHONE PLUGS

Standard P.M.G. Type Phone Plugs.
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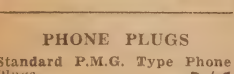

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● SPECIAL SLOW SPEED MOTOR

24-volt approx. 1/16th H.P., reversible motor, fitted with 5000 to 1 reduction gear and magnetic brake. **£2/17/6**

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80-volts with laminated field. Approx. 1/10th H.P.
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Combined 24-volt motor and High Pressure Hydraulic Pump, 600lbs./square inch. **£3/15/-**

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24-volt A.C., D.C., 1/40th H.P. with laminated field. **50/-**

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4000 ohm, suitable for crystal sets.
PRICE, per pair **25/-**

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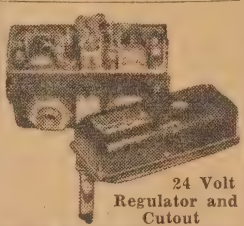
BATTERY CHARGING GENERATORS

All generators checked and tested before despatch.

	£	s	d
24 volt, 1500 watt	15	0	0
12 volt, 500 watt	10	10	0

The 24 volt, 1500 watt Generator can be used for 32 volt system without any alteration.



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Complete with chart. PRICE ..
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THE "PIONEER COMPASS"

A liquid filled Compass with drum type dial made by Bendix Aviation Corporation U.S.A. Can be fitted to the dashboard of a car. PRICE. **£3/10/-**
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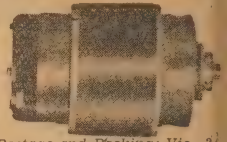
SELSYN MOTORS

50 volt, 50 cycle, ideal for use with Rotating Beam Aerial **30/-**



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COMPASS

Liquid Damped, Card Type 6½" dia. x 3½" deep, fitted with large viewing prism, idea for small craft, &c., for normal navigation and also taking bearings.
PRICE, each **£6/10/-**

BELL RINGING GENERATORS

A small neat A.C. Generator complete with handle and 4 screw fixing base. Change over shaft actuated contacts for telephone ringing, shocking, etc. suitable for converting Don. V. phones to bell call. **37/6**

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SELECTOR SWITCHES

12/24 volt D.C. operate four way. Yaxley type Switch; will motor and automatically stop at any switch position, ideal for remote control, etc.
PRICE, each **7/6**

Postage 1/9 all States.

f a metal plate with a number of lifferent size holes punched in it nd, by sliding or rotating this, the equired opening could be brought in ront of the lens.

On the other hand, quite a numer of recent models provide a built-n portrait attachment which can e moved in front of the lens when equired. This enables photographs o be taken at a distance of around hree feet and opens up a whole ange of subjects which are not nor-nally suitable for such simple equip-nent.

Apart from the above, no focus-ng mechanism is provided, the lens ormally being set at between 12 nd 15 feet, a distance which is more r less automatically adopted when hotographing full-length subjects. he size of the lens is so small that ocusing is not particularly critical, nd subjects from about seven or ight feet onward will be reason-bly sharp.

CORRECT EXPOSURE

The combination of lens size (usu-lly about f 11) and the shutter speed rovides approximately correct ex-osure under bright sunlight con-itions, although the latitude of odern films will sometimes result n acceptable pictures under some-hat adverse lighting.

Summing up then we may say hat the box camera gives best re-ults in bright light, with the sub-ect at a distance of about 12 feet, hile some models can also work at hree feet and can give longer ex-osures where necessary.

Next comes the folding camera. very large range comes under his heading and we can only ope to cover the general types. irst there is what has been called he "folding box camera" and, while his may appear a contradiction in erms, it is a fairly apt description f a folding camera which has lens nd shutter equipment identical with box camera.

In this case the extra cost merely rovides the convenience of being ble to fold the camera when not n use, and while this is a handy eature, it does not assist in taking etter pictures. So don't fall for he popular misconception that any olding camera will take better pic-ures than a box—it won't, unless has a better lens and shutter.

COMPROMISE LENS

Coming to more elaborate types e find models having larger and etter quality lenses, a popular com-romise with cost being the f 6.3 nastigmat. This is usually found n shutters having a range of three r four speeds such as 1/100, 1/50, /25, and sometimes 1/10, as well s time and bulb. Control of the ght through the lens is by means a continuously adjustable dia-hragm, and having the popular iaphragm numbers marked on the ns housing. Apart from box ameras this type of diaphragm is sed in practically all lenses at the resent time.

With lenses of this aperture, or rger, it is necessary to set the lens orrectly according to the distance to the principle object, and the usual range of adjustment is from three feet to infinity. The addition of focusing facilities is a distinct advantage, but it is also an additional responsibility, as the user now has either to measure or calculate the distance involved. In the case of the f 6.3 lens the largest aperture still has some depth of field, so that precise adjustment is not essential.

In the popular 120 or 620 sizes (2¼" x 3¼") the largest lens is usually f 4.5, while the 2¼" square sizes usually extend to f 3.5. Both these lenses admit a lot of light and are very useful under poor lighting conditions. However, the focusing is very critical and, in many cases, it is necessary to measure the distances involved to ensure results which will do the equipment justice.

A range finder is very useful with cameras of this type, as it enables the distance to be accurately measured without the user moving from the taking position. It is, of course, an additional expense, and it takes time to transfer the information from the range finder to the focusing mechanism, but there are many cases where this is quite practical and much more convenient than a physical measurement.

More advanced models have range finders built in as standard equipment and, in many cases, this is coupled to the focusing mechanism, so that as the range finder is adjusted the camera is adjusted also. This makes possible very rapid working and, if the range finder and view finder are combined, even greater convenience is provided. However, this usually puts the instrument into a much higher price class.

SHUTTER SPEEDS

A wide range of shutter speeds is usual with these models, a typical selection being: 1, ½, 1/5, 1/10, 1/25, 1/50, 1/100, with a top speed of between 1/250 and 1/500 of a second this last being dependent on the size of the shutter. Many makers are offering the larger lenses in shutters having only three or four speeds, the lower price being attractive to those who require a large lens but do not consider the wide range of shutter speeds justified.

The view finders on many folding cameras leave a lot to be desired, the area of field indicated often being far from accurate. This seems to be particularly true of the eye level finder which has almost entirely replaced the waist level finder.

Body mounted shutter releases are standard on most folding models today, but there are a few which do not possess this feature, even though they have only eye level view finders. It is almost impossible to hold one of these at eye level and avoid shaking the camera when operating the shutter—a difficult enough problem at any time.

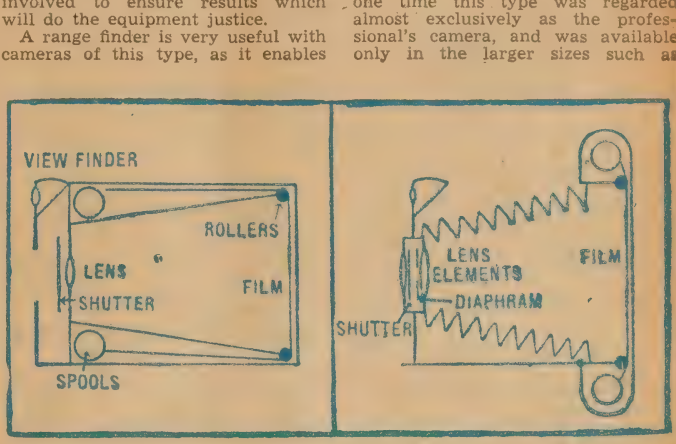
Next comes the reflex camera. At one time this type was regarded almost exclusively as the professional's camera, and was available only in the larger sizes such as quarter plate and 5" x 4". Later it appeared in the 35 mm size, then the 127 (2¼" x 1 5/8") and more recently in a 2¼" square model. It seems a pity that the variety has been so limited, since the type much to recommend it.

The shutter no longer forms part of the lens mount, but is located in the focal plane, that is, immediately in front of the film. In operation a narrow slit passes in front of the film, exposing only a small part at a time, and by varying the width of the slit and the speed at which it moves a wide range of effective speeds may be obtained, including much higher top speeds than are possible with between-the-lens shutters.

Interposed between the lens and the focal plane is a mirror set at 45 degrees and reflecting the image from the lens onto a ground glass screen lying horizontally above it. This screen is hooded to exclude external light, providing a view finder that gives a picture the same size as the final negative.

REFLEX ACTION

The distance rrom the lens to the ground glass screen, via the mirror, is carefully adjusted to be exactly the same as that from the lens to the film, so that the ground glass may



The diagram on the left shows the essential parts of the ever popular box camera, the emphasis being on simplicity. On the right is the folding camera showing minimum requirements. Individual models show considerable variety in additional refinements.

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A perfectly ground prism, originally used in tanks for periscopic sighting. Two of these prisms will give full periscopic effect; one prism will give upward sighting. Original cost to Army, £6/15/-. Special Price, each **10/6**

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Our Price **£3/15/-**

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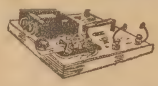

Genuine PMG Morse Keys, with adjustable buzzer, brand spanking new. Cost the Army, £4/10/-.
OUR PRICE .. .. **7/6 ea.**
Without batteries, which are easily obtained at any electrical store.

Postage: NSW, 2/2; Interstate, 3/3.

ONLY 7/6 ea.

Bearing & Distance Plotter

For measurements of bearings and distances. It is provided with a protractor and scales. Made of Celluloid.
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A super precision-made instrument. All aluminium. Original cost to RAAF £24. Our price, complete with well-made wooden case, 12" x 12" x 4".
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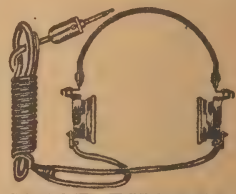

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e used for focusing as well as view-
g the subject.

When the shutter release is pressed
e mirror is swung upwards to a
osition immediately under the
round glass, thus allowing the
nage to fall on the film as it is un-
overed by the shutter. The timing
f this procedure is such that the
utter does not commence to move
ntil the mirror is well clear of the
ght rays.

The advantages of this scheme are
any. The large view finder makes
mposition relatively simple and, as
e image is taken from the picture
ns, there is no suggestion of par-
lex error, irrespective of the work-
g distance. Since the shutter is
dependent of the lens, the latter
ay be removed quite readily, even
hile the camera is loaded, and re-
laced with one having a different
cal length. Further the effect of
e new lens is immediately appar-
nt on the ground glass.

There are two minor disadvan-
ges associated with this type,
hich it is just as well to keep in
ind. Since the focal plane shutter
oes not expose the whole area of
lm simultaneously, moving objects
n be seriously distorted if it is not
rrectly used. Avoiding these effects
ally boils down to learning how to
se the equipment.

ENS DIAPHRAGM

The second point deals with the
ns diaphragm. When this is closed,
reduce the light which will reach
e film when the shutter is released,
e image on the ground glass will
e dimmed to the point where it may
longer be of much value. This
tuation tends to become worse as
dvantage is taken of more sensitive
ms. One maker solved the problem
y coupling the diaphragm to the
utter release, so that when the
lease was pressed the diaphragm
as closed to a value which had
een pre-set by the operator. Un-
rtunately this idea has not been
nerally adopted.

However it must be realised that
ese disadvantages are only minor,
nd that the extreme versatility of
e instrument far outweighs them, a
ct which is demonstrated by their
ntinued popularity with the pro-
ssional photographer for very many
ears.

The twin reflex camera may be
garded as the amateur version of
e reflex and is a type which is
coming increasingly popular. The
icture lens is not used to provide
e view finder image, but a second
ns having identical focal length is
sed. As with the reflex, the image
om this is taken via a mirror to a
round glass screen which is the same
ze as the negative, and provided
ith a light-excluding hood.

WIN REFLEX

The viewing lens and the taking
ns are both operated from the same
cusing mechanism, so that the
king lens may be adjusted by means
the image on the ground glass, in
ctly the same manner as with a
ue reflex. The use of separate
nses must produce some parallex

(Continued on Page 96)

PORTABLE ELECTRIC PHONOGRAPH
240 VOLT A.C. MAINS OPERATED

This self-contained portable electric phonograph is housed in a leatherette covered carrying case and is complete ready to operate from any 240 volt A/C power or light socket. It has an amplifier with 8" speaker and electric phonograph motor and crystal pickup built into the cabinet. It is equipped with a volume control and on-off switch.

Supplied ready for use with 2 yards of power lead at **£19/17/6**

Freight and packing £1 extra. Country Orders accepted. C.O.D. N.S.W. only. Cash with order Interstate.

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Insulated Pliers

5000 volt handles with wire cutters 6½"

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78-in. Flexible Steel Tape Rule. Rolls into metal case, 2in. in diam.

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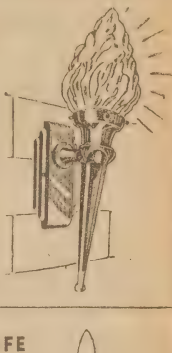

Exterior torch we a therproof lantern with flame shape glass shade.

£2/5/-

£2/10/- packed and posted.

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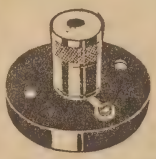

The "Red Spot" highly sensitive, semi-fixed permanent crystal detector is now available from Radio House Pty. Ltd. for 9/6, 10/- posted. The "Red Spot" will take the place of the old type crystal and cat-whisker and give much better and more constant results. When necessary, it is easily adjusted by means of the knurled cap as illustrated.

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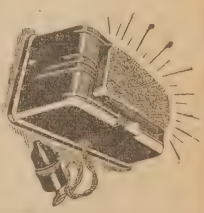

Spare battery standard cycle type No. 701, 2/6 each.

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6 ROYAL ARCADE SYDNEY. Opp. Queen Victoria Bldgs.

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PF 182	240	12	200	40	12.6V CT @ 1A	55/10
PF 126	240	12	250	60	12.6V CT @ 1A	65/4
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A	109/8

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CF 101	30	870	25		30/-
CF 102	15	300	60		20/10
CF 103	30	420	60		43/9
CF 104	30	580	75		46/6
CF 105	15	250	80		39/1
CF 106	12	200	100		39/8
CF 107	30	360	100		53/8
CF 108	12	135	150		56/-
CF 109	20	225	150		58/4
CF 110	12	100	200		67/10
CF 111	16	165	200		67/10
CF 112	10	70	250		67/10

SPECIAL CHOKES

					Retail
CF 113	.5	70	250		
	20		50	Swinging choke	74/6
CF 114	1.1	23	375	Ballast choke	46/8
CF 115	.017	.6	2 amps	L.T. choke	20/5

OUTPUT TRANSFORMER TO VOICE COIL

Full Frequency Range (30-15000)

Code No.	Pri. Imped.	Sec. Imped.	Watts	Retail
OP24	5000 SE	8.4, 2.1, with feed back	5	69/10
OP23	3250 SE	12.5, 8.4, 2.1	10	102/-
OP19A	5000 PP	12.5, 8, 2.3	15	148/7
OP51	4500 PP	15.5, 12.5, 8.6, 2.7, 2	20	139/3
OP63	10000 PP	15, 3.75	15	158/6
OP64	10000 PP	12.5, 3.125	15	158/6
OP65	10000 PP	8.4, 2.1	15	158/6

OUPUT TRANSFORMER TO VOICE COIL

Special Full Frequency (20-30,000)

OP25/40	10000 PP	40, 10	15	8/6/8
OP25/16	10000 PP	16, 4	15	8/6/8
OP25/15	10000 PP	15, 3.75	15	8/6/8
OP25/12	10000 PP	12, 3	15	8/6/8
OP25/10	10000 PP	10, 2.5	15	8/6/8
OP25/8.4	10000 PP	8.4, 2.1	15	8/6/8
OP66	5000 PP	8.4, 3.7	15	199/6
OP67	5000 PP	15, 6.5	15	199/6

OUTPUT TRANSFORMER TO LINE—

Full Freq. Range.

OP22	3250 SE	500, 125, 8.3	10	102/-
OP19b	5000 PP	500, 250, 125	15	148/7
OP21	8000 PP	500, 250, 125	15	121/4
OP62	10000 PP	500, 125	15	158/6

OUTPUT TRANSFORMER TO LINE—

Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	8/6/8
OP25/250	10000 PP	250, 62.5	15	8/6/8

VIBRATOR TRANSFORMERS

Code No.	Pri. V.	D.C. Out.	MA. Buffer Full Sec.		Retail
VT 100	32	200	40 .005	Sync.	46/1
VT 101	6	90	15 .008	"	36/2
VT 102	6	150	25 .005	"	37/9
VT 103	6	200	50 .005	"	35/6
VT 104	6	250	60 .005	"	42/-
VT 105	12	250	60 .005	"	45/6
VT 106	6	300	75 .008	"	74/10
VT 107	6	250	60 .005	Sync. Low Rad.	46/6
VT 108	12	90	15 .008	Sync.	37/6
VT 109	24	90	15 .008	"	39/8
VT 110	12	150	25 .005	"	37/9
VT 111	24	150	25 .005	"	42/7
VT 112	12	200	50 .005	"	44/6
VT 113	24	200	50 .005	"	45/6
VT 114	12	300	75 .008	"	81/1
VT 115	24	300	75 .008	"	82/1
VT 116	24	250	60 .005	"	46/6
VT 117	12	250	60 .005	Non Sync. Low Rad.	45/6
VT 119	32	150	25 .005	Sync.	42/-
VT 121	6	180	30 .005	"	44/4
VT 122	6	400	50 .005	"	76/5
VT 123	12	320	125 .005	Sync.	98/-
VT 124	32	250	60 .005	"	49/-
VT 127	6	200	50 .005	Sync. Low Rad.	46/6
VT 128	12	250	60 .005	Sync. Low Rad.	54/1

RECEIVER POWER TRANSFORMERS

Code No.	HTV Prim.	Aside	M.A.	Filaments	Retail
PF 185	240	150	30	6.3V @ 2A	45/6
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	49/-
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	45/6
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	51/1
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	60/6
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	64/9
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	68/-
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	70/-
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	79/4
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	88/8
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	99/2
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	93/2
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	116/1
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	159/8
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	168/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3 @ 3A, 5V @ 3A	111/1/8
PF 201	240	225	50	6.3 @ 2A	46/6

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	
MT111	500	12.5, 8, 2.3	10	62/10
MT100	600	4, 3	15	58/4
MT101	500	15	15	58/4
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	98/-
MT125	600, 500	15, 12.5, 8.4, 6.5	25	95/8

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	154/-
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	177/4
MT120	500 to 20000 in steps.	500 to 30000 in steps.	50	324/4
MT121	500 to 20000 in steps.	500 to 30000 in steps.	125	320/10

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	10	61/8 74/8
OP39	5000, 2500 SE	15	10	
OP33	5000, 2500 SE	5, 2.7	10	65/10
OP41	5500 SE	3.7	10	65/10
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	73/8 65/8
OP2	5000 PP	12.5, 8, 2.3	15	99/1
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	99/10 109/6
OP3	6600 PP	12.5, 8, 2.3	15	99/10
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	99/1 109/6
OP4	10000 PP	12.5, 8, 2.3	15	
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	99/10 109/6
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	99/10 110/10
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	138/10
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	32	177/2

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	61/8
OP44	5000, 2500 PP	500, 250, 125	10	77/-
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	119/-
OP6	5000 PP	500, 250, 125	15	99/1
OP7	6600 PP	500, 250, 125	15	99/1
OP50	8000 PP	600, 300, 120, 60, 30	15	205/8
OP8	10000 PP	500, 250, 125	15	99/1
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	5/7/10
OP9	10000, 6600, 5000 PP	500, 250, 125	15	99/1
OP10	5000 PP	500, 250, 125	25	120/7
OP11	6600 PP	500, 250, 125	25	120/7
OP38	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	25	205/8
OP12	10000 PP	500, 250, 125	25	120/7
OP13	10000, 6600, 5000 PP	500, 250, 125	25	120/7
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	170/4
OP14	5000 PP	500, 250, 125.	32	146/1
OP48	6600 PP	140, 70	32	177/4
OP15	6600 PP	500, 250, 125	32	146/1
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	177/8
OP16	10000 PP	500, 250, 125	32	146/1
OP17	10000, 6600, 5000 PP	500, 250, 125	32	146/1
OP36	3800 PP	77.6	60	177/4
OP18	3800 PP	500, 250, 125	60	155/6
OP61	3800 PP	100, 75, 50, 25, 10, 5, 2	60	202/1
OP37	6400 PP	500, 250, 125	80	214/8
OP49	8800, 6000 PP	500	105	328/6
OP20	11600, 8400 PP	500, 250, 166, 125	150	320/10

ALL PRICES SUBJECT TO ALTERATION WITHOUT NOTICE

HAND CAPACITY WORKS RADIO BIRD

An oscillating circuit, critically adjusted, can be made to operate a variety of gadgets when affected by hand or body capacity. The following article tells how it is done. Use of a high radio frequency and a metal shield box prevents radiation of R F power from the unit.

THIS interesting novelty makes use of a valve oscillating on a high frequency, and the anode current fairly large when both anode and grid circuits are tuned to the same frequency.

A metal object (about which more later) is connnected to the grid circuit as L1 in Fig. 1, and when a person's hand approaches this object the resonant frequency of the grid circuit is changed; the valve almost ceases to oscillate and the change in anode current operates a relay.

When the circuit is correctly adjusted the relay will operate when a hand is brought within a few inches of the metal plate connected to L1. This effect can be used to bring about a number of startling and amusing results, all totally unexpected by the individual responsible. The plate connected to L1 may take many forms—a metal ashtray can be used, or a piece of metal or foil concealed under a tablecloth, or even under the table itself.

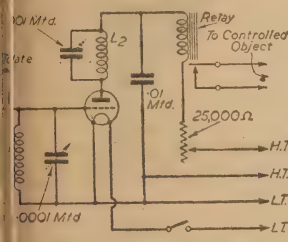


Figure 1 — Theoretical circuit.

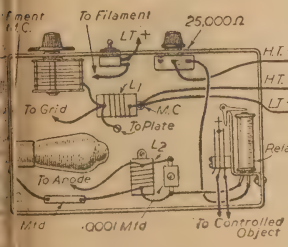


Figure 2 — Wiring diagram

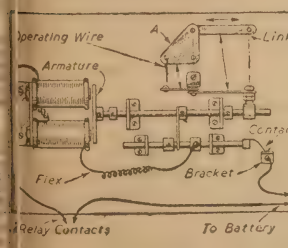


Figure 3 — The automatic electrically-operated mechanism.

The operation of the relay can bring about a number of effects. For example, a radio receiver can be connected so that when anyone approaches a hand to it for tuning, &c., the set switches itself off, only to come on again mysteriously when the hand is withdrawn.

For children, a jack-in-the-box arrangement could be tried, Jack withdrawing into the box and allowing the lid to close when a hand is put near. Even a suitably humorous text, placed behind an ashtray, and illuminated when a person's hand comes near, is quite effective.

If the words are cut upon thin card with a razor blade and placed behind thin colored paper, no lettering will be visible when the bulb is out and any smoker caught with his hand still some inches from the tray will be astonished.

Other arrangements will readily suggest themselves and only one will be described in detail. In this a small wooden parrot pecks violently when a hand approaches the ashtray forming his feeding bowl. The action ceases when the hand is withdrawn.

THE OSCILLATOR CIRCUIT

This, together with the layout, is shown in Figs. 1 and 2. Coils L1 and L2 each consists of five turns of 22 SWG tinned copper wire on a ¾in diameter former, the turns being spaced about ⅛in.

Actually, these coils are not critical provided the frequency tuned is fairly high. L1 is tuned by means of a .0001 mfd variable condenser, preferably with a small reduction drive. A small preset condenser of about .001 mfd maximum capacity is wired in parallel wtih L2.

A 2-volt small-power valve was found to give excellent results, anode current being 2½ milliamps when the circuit is not oscillating, rising to 6 milliamps when oscillation occurs. However, other valve types can be used. A 1.4 volt "all dry" receiver-type valve was found to be satisfactory and a mains valve could, of course, be used, provided suitable supplies were available.

The relay is a 250-ohm ex-service one and operates strongly with an anode current of 5 to 6 milliamps, opening sharply when the current falls to half this figure. Such relays are easily obtainable. A relay already to hand may prove suitable, even if intended for larger currents, if the return spring is weakened by stretching.

The 25,000-ohm resistor is advisable as this enables the anode current to be adjusted so that the relay operates properly.

None of the other parts requires mention, and the whole may easily be built in a toffee-tin or similar container.

An insulated lead passes through a hole to the metal plate to which we have referred already. By keeping all batteries well away out of sight and disguising the nature of

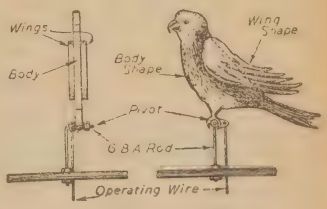


Figure 4 — Details of the movement for actuating the mechanical bird.

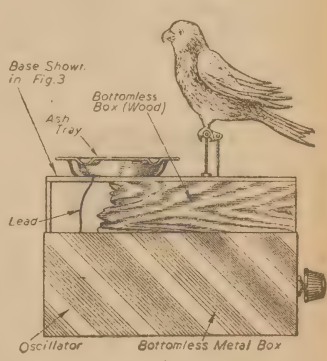
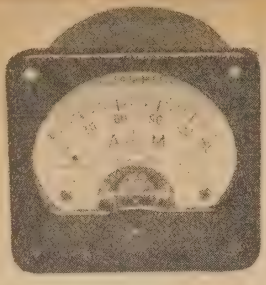


Figure 5 — Side view of the apparatus showing the wood and metal casings.

the apparatus the effect will be greatly enhanced.

It is desirable to connect a meter in series with one HT lead as a beginning. The variable condenser should then be adjusted until the anode current peaks sharply. The maximum anode current will depend upon the valve type, setting of the 25,000-ohm variable resistor, and HT voltage.

With the valve mentioned 60 volts was ample with a variable resistor set about midway. If the anode current of the valve keeps the relay closed when the circut is not oscillating, the anode voltage should be reduced by means of the 25,000-ohm resistor.

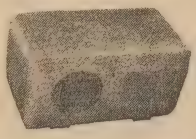


METERS

We have the following meters in stock. They are mostly brand new and if not they are in excellent condition.

Type of meter	
0—1, M.A. D.C. 2in. scale .. .. .. square	32/6
0—20, 0—200 D.C. volts, 2in. scale .. round	17/6
0—5 amps R.F. 2in scale .. .. .. round	22/6
0—40 volts D.C. 2in scale .. .. .. square	19/6
0—3 amps R.F. 2in scale .. .. .. round	22/6
0—2.5 amps R.F. 2in scale .. .. .. square	22/6
0—50 M.A. D.C. 2in scale .. .. .. square	22/6
0—100 volts A.C. 2in scale .. .. square	39/6
0—20 volts D.C. 2in scale .. .. .. square	19/6

Please note the 0—100 volt A.C. meter is an excellent buy as it has a 1. M.A. dry metal rectifier. Valued at 35/- built into each meter.



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Similar to above but 11" x 7" x 7". Usual price 27/6.

Our Price **16/6.**

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Assorted bundles, all wattages and values, mixed ½ watt, 1 watt, 2 watt, 5 watt, from 100 ohms to ½ meg, 5 per cent and 10 per cent accurate. An excellent buy.

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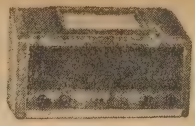
50 assorted	15/-
100 assorted	27/6
500 assorted	125/-



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For 5-Valve Mantle Radio for either A.C. or Battery use.
Kit consists of:—

Nicely figured Walnut Cabinet with chenille velvet speaker cloth. Overall dimensions 17" x 10½" x 8½".

Dial Glass, Dial Drive Assembly. Specially constructed chassis to fit into cabinet with welded front plate into which loudspeaker and dial assembly part fit.

Ideal for the home constructor. Easily worth £6/10/-.

Our Price **£3/15/-.**

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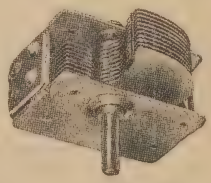
Bargains in heavy duty rheostats I.R.C. 250 ohm 25-watt wound on Mica and porcelain insulated as illustrated. Price **4/6.**

100 ohm Heavy Duty Rheostat as used in English Aircraft.

Price **2/3.**



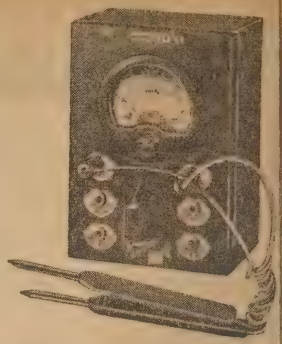
SINGLE GANG CONDENSERS

Ideal for Crystal Sets, etc., capacity approximately .0005. Brand new and perfect. Easily worth 12/6.

Our Price **8/11.**

NOTE

All parcels will be sent registered post unless otherwise stated. Postage or freight must be included with all orders.



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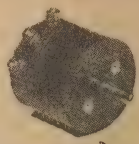
The ideal pocket size meter f measuring voltages of electric circuits and checking continuit of circuits, etc. Volt Scales 0—1 0—150, 0—300, 0—600, D.C., Ohm Scale 0—50,000. The cheapest an smallest on the market. Com plete with prods and battery; ca be carried in your coat pock with ease.

Price **£3/9/6.**

SPECIAL BARGAIN IN SPEAKER

6" permag Cadet Speakers wi transformer, 5000 ohms impe ance, for **17/6**, less transforme for **12/6.**

These speakers have damag cones. New cones to suit **1/6** e



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Heavy duty wire wound pote tiometers, value 270 ohms, wor 7/6.

Our Price **3/-.**

CARBON POTS

With short shaft, screw dri adjustment, 1500 ohms, just t thing for adjustable bias resisto Worth 4/6.

Our Price **1/3.**

MOTOR SPARES LTD.

547 ELIZABETH STREET, MELBOURNE

ne tuning condenser in parallel L1 will require slight re- ng if the object connected to the e grid is changed or the position, ength of the intervening flexible is modified.

ne relay should be heard to ate sharply when a hand is ght within a short distance of plate and the variable condenser accordingly be set without dif- ty. With careful adjustment of le current and tuning, the relay operate when the hand is some es from the plate.

wo leads are taken from the relay acts which close when the relay ot energised (i.e., when the valve es to oscillate). These leads may taken to a battery and bulb, tric motor, solenoid, or other ratus as desired.

CTRO-MAGNETS

small electric motor with re- ion drive and crank would be ible, but the arrangement shown ig. 3 uses electro-magnets, and s a sharp backward and forward on.

ne method of operation of the is as follows: When the battery magnet circuit is completed the act shown is touching the small ket. The magnets are therefore gised and the armature drawn ne left.

s full movement to the left is hed the projection strikes one he collars on the shorter lateral bringing the contact away from bracket and breaking the elec- l circuit.

ne weight of the bird's tail then vs the armature away from the nets and when the full move- t to the right has arisen, the pro- ng arm strikes the second (right- d) collar, thereby bringing the act spring against the bracket. his motion is therefore continued l the relay contacts open, being lar to that for maintaining oscil- ns to the pendulum of some tric clocks.

ERATION OF ARMATURE

ll the parts should move smoothly. s, collars and brackets are found well-known constructional set greatly simplify construction. backward and forward move- t of the armature is transferred an up-and-down motion by the k "A," the operating wire passing ctly down through the base- rd shown in Fig. 3.

he complete movement of the ature will be only about %in the operating wire is accordingly ted to the parrot's body at a t very near the pivot (perch) ut which it moves. This is shown ig. 4.

he bird should be quite light about 3½ or 4in long. The body tail is cut from one piece of y and the wing shapes from lar material, one being glued on side of the body piece. Just icient weight is added at the end of the bird to make this and it is this which withdraws armature from the magnets.

he magnets themselves should be of good power. Bobbins about 1¼in long and 1in in diameter wound with 14 SWG wire can be used for a 2-volt supply the same accumulator being used as for supplying the valve.

The armature must be of iron, and is soldered to a collar on the sliding rod. If all the collars are held with set-screws final adjustment will be facilitated. All the parts should move freely, and a little thin oil on bearing surfaces will be helpful.

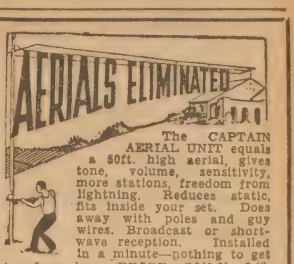
CONSTRUCTION

With the units as described, the oscillator in its case can form a base. The operating mechanism can rest on top of this, forming a platform for the bird and ashtray, which should be a fairly large one if the movement is to come into action when the hand is still some inches away. This is shown in Fig. 5.

The bird should be finished off in bright red and green and the tuning and other controls are at the back out of sight. Once these are set, no adjustment is required unless some modification is made as mentioned.

Finally, the circuit oscillates by virtue of the grid-anode capacity. If screen-grid or pentode valves are employed it is necessary to connect screen grid and anode together and employ these as anode, or connect a small condenser of about 10pf from grid to anode, otherwise oscillation may not be obtained.

As mentioned, a small-power triode is the type with which satisfactory results may most readily be obtained and with such a valve, and a suitable relay, no difficulty whatever should be experienced in adjusting the circuit correctly.



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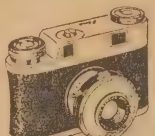

ILOCA II: 35 mm. camera with coupled rangefinder F3.5 coated lens. Prontor-S shutter 1 sec. to 1/300 T. & B. flash contacts.
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ROBOT: 35 mm. camera with built-in motor for 1, 2 or 24 automatic pictures. F3.5 Radionar lens, shutter speeds ½ sec. to 1/500 sec.
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Brand New Head-band type Magnifiers

Made in England
Optically ground Lenses.
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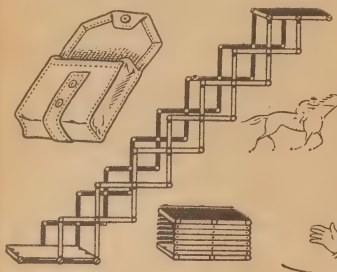

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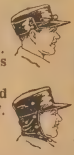

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12/9 each.

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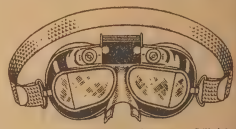

Ideal for Motorcyclists, **37/6 pa**

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HANDPIECE
Brand New .. .. **25/- each.**
Burrs, 2/6 packet of 5.

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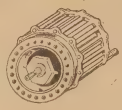
Can be used as Low Pressure Compressors or for Low Pressure Spray Guns, Brazing.



Useful for Gas Torch
55/-

Glass Blowing or Tinning, etc.

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Ideal for campers, cyclists, hikers.

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Direct from English Army disposals.

Brand New American Vacuum or Air Pump

Builds up air pressure to 30lb. at 1000 R.P.M. Develops up to 120lb per square in. of hydraulic pressure, will pump 7½ gals. S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems **£3/15/-**

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Ideal for Flyers, Motor Bike Riders, Farmers, Tractor Drivers. Heavyweight Waterproof Material. Fitted with

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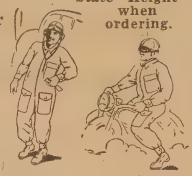
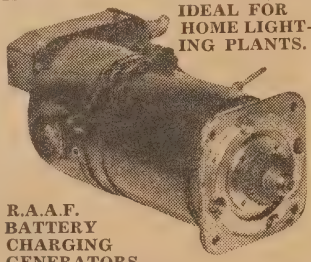


Zip Fastener Front £6/10/0

IDEAL FOR HOME LIGHTING PLANTS.



R.A.A.F. BATTERY CHARGING GENERATORS
24 volt, 1500 watt **£15/15/-**
Brand New English Lucas, 12 volt or 24 volt **£10/15/-**

RAAF AIRPLANE COMPRESSOR
Two Stages
Limited Numbers
Highest Quality
£5/5/-

Made in England. Brand New 5 in 1 POCKET SCREWDRIVERS
Ideal for Engineers, Mechanics, Hobbyists, 5/9.
Carry one in your pocket. 5 screwdrivers in one.

BRAND NEW AMERICAN PUM

USED BY THE R.A.F.

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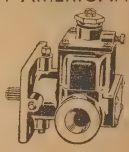

WILL PUMI ANY LIQU

400 galls. per hour 55

BRAND NEW CAR FIRE EXTINGUISHER

Genuine Pyrene. Fit one to your car.

Made in U.S. Worth £5/10/- **OUR PRICE £3/5/-**
Ideal for Trucks or Caravans
Limited Quantity Available.

SURGEON'S SCALPEL
6/6 each
Many other uses—Hobbyists Chiropody, Photography, etc

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Ball and Socket Jointed Inspection Mirror

Ideal Motor Mechanics, Radio Mechanics, Engineers, etc., 8/6 each.

A Lucky Re-purchase, £3/19/6

Brand New Army Phones Ideal for Farms

Install one in your workshop or house. Equal to P.M.G.

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OLT CUTTERS
Extra Strong.
Cut anything, 15/- Pair.

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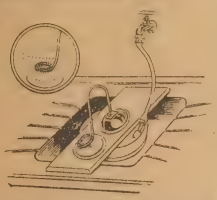

RAND NEW ENGLISH BLOWER
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Work off
2 or 24
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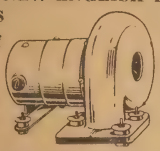

Will work off 32 volt Lighting Plants
55/-
FIT ONE TO YOUR CAR.
BETTER THAN A FAN.

AT LAST! British Army Issue
DOUBLE SCALE VOLTMETER
0-15 0-250 VOLTS

IDEAL
FOR
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USERS
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OR HOBBYISTS

27/6
Worth £3/15/-

BRAND NEW AIR COMPRESSOR
2.2 cubic feet, will pump up to 75lb.

Never before at this price.

Ideal for spraying.
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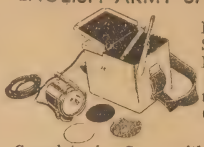
LUCKY PURCHASE BRAND NEW ENGLISH ARMY SPOTLIGHTS



Ideal for Shooting, Fishing, etc. **Fit one to your Car.**
29/6
Complete in Case, with Red, Amber and Green Discs.

WATCHMAKERS AND INSTRUMENT MAKERS

English Tweezers 5/6
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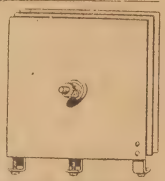
Single Drivers, 5 sizes . . 2/6 to 3/6
Eyeglasses . . . . . 6/6 and 8/6
Extra strong double lens eyeglass 15/-

BRAND NEW ENGLISH RECTIFIERS
Make yourself a Battery Charger
6v 2 amp . . 24/6
6v 5 amp . . 32/6
12v 5 amp . . 57/6
Transformers to suit above Rectifiers, 2 and 5 amp. 6 volt only, 37/6.



IN FIRST-CLASS ORDER

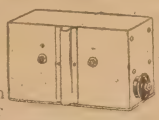
DALTON COMPUTORS IDEAL FOR AERO CLUB A.T.C., ETC.

Only Limited Stocks Available. Be Early
45/-

Engineers Special Outsize Screw Calipers, 4" Dividers and inside Screw Calipers, each 5/6

AT LAST
Complete Battery Charger

Fitted with brand new English Selinium Rectifier



Works off 230v. A.C. Household Supply.

Charges any battery from 2 to 6 volts at 5 amps. **£5/15/-** complete.

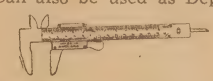
BRAND NEW BRITISH
English 150 amp A.C.—D.C. Meters, 3½" dia. Ideal for generators, 57/6.
0-1 Milliammeters, 2½" diameter, 32/6

Brand New American Weston Voltmeters 0-50V, £2/2/-

0.50 volts, 0.100 amps, combined, **£3/10/-**

0-10 Weston Ampmeters **50/-**

BRAND NEW ENGLISH VERNIER CALIPERS
Will measure inside and outside. Can also be used as Depth Gauge.



25/-

Ideal for all types of engineering work. Measures in ins. and m/m Can be carried in the pocket.

Motorists Trouble Lights
Work off any Car Battery
12 volt **4/6**
Every motorist should have one.

THIS MONTH'S BARGAIN LIST

English Diagonal Cutting Pliers, **6/6**
Extra Long Nose Radio Pliers, 8" long, pair **9/6**
American Feeler Gauges **8/6**
Dental Inspection Mirrors . . **5/6**
Pressure Gauges, 0-2001b . . **25/-**
Genuine British 4-draw 22 magnification Rifle Range Telescope **£6/19/6**
Pocket Compasses, English . . **5/9**
Pocket Telescopes **12/9**
Pocket Folding Telescopes optic glass lenses. Good range **57/6**
Brand New Micro Switches . . **8/6**
Morse Keys and Buzzer. Ideal for Boy Scouts. Cost £5, for **10/-**
Brand New English headphones complete with cord & plug, **17/6**
20-20 Car Type Ampmeters . . **12/6**

BRAND NEW ENGLISH AMP METERS
50-0-50 Amps, 32/6
20-0-20 Amps, 27/6
0-20 Voltmeters, 25/-
0-5 RF Ampmeter S. 15/-

Telephone FJ5904

INCLUDE STATE IN ADDRESS
and efficiently Despatched
ALTERATION WITHOUT NOTICE

SHORT WAVE NOTES BY RAY SIMPSON

INTERNATIONAL GOODWILL STATION OTC

In these days of bickering and dissension between nations it is pleasing to hear of any country or even organisation who is trying to cement friendship and understanding. To this all too small group we are happy to welcome the Belgian National Broadcasting Station in Leopoldville, Belgian Congo.

PRACTICALLY all listeners have heard this station, OTC, on 9.767 Mc and usually its strength makes for very enjoyable listening. One of their most interesting programs is Among Friends, which takes the air daily at 10.10 am and is repeated in Swedish alternate Fridays at 5.10 am.

Every Wednesday the English program is devoted to Short Wave News for DX-ers and radio amateurs and features news and information from various radio clubs throughout the year. A preview of the coming week's musical program is broadcast every Monday at 5.10 am. Other programs from this station are Belgium Calling the Netherlands and South Africa, Belgium Calling Her Countrymen Throughout the World, Belgium Calling Great Britain and the British Territories.

For those listeners who like to obtain a verification confirming their reception will be very pleased with the new QSL card sent out by this station. It features a transmitting tower in black and at the base is a black dot and the word, Leopoldville.

VERIFICATION CARD

In orange outline is a map of Africa and the Belgian Congo in black. The bottom of the card is a one-inch wide six-inch long jungle scene sketched in black on an orange background. From the transmitter are black waves with Belgium Calling the World and the letters OTC in orange. The O is small, the T larger and the C still larger. Underneath this are the words The International Goodwill Station in the Heart of Africa.

On the reverse side is a cartooned sketch of the technician at the transmitter and the words coming out of it: This is the Belgian National Broadcasting Service in Leopoldville, Belgian Congo. Hello, everybody. The sketch is in black against a white background. At the top of the card in orange is "La Voix de la Concorde—de Vriendschapsbode and at the very bottom Belgie Spreekt tot de Wereld la Belgique Parle au Monde.

For one dollar they enrol one in the Among Friends Club and will send an attractive lapel pin. Along with this pin members obtain a cord printed in three languages and details of the club, which has all the usual departments. One night they give stamp news, the next a photography corner, DX news and mailbag, &c. They also supply members with a list of pen pals in all countries and a stamp exchange is also conducted.

A complete list of the Leopoldville stations is as follows: OTC2, 9.767 mc; OTC3, 11.645 mc; OTC4, 15.17 mc; OTC5, 17.745 mc; OTC6, 21.68 mc; OTM1, 6.293 mc; OTM2, 9.4 mc; OTM4, 11.718 mc. There is also another station on 9.21 mc with the call OTH.

STATION ADDRESSES

CXA13—Radio Carve, Avenida 18 de Julie 1342, Montevideo, Uruguay.
HJFB—Radio Manizales, Apartado 175, Manizales, Colombia.
ZYE7—Radio Ecuadora de Parnaiba, Avenida Jaime Rosa 1190, Parnaiba, Brazil.
DZI3—Radio Station DZBB, Calvo Building, 4th Floor, Escolta, Manila, Philippines.
DYB2—Bacolod Broadcasting Co., Kizal St., Bacolod City, Philippines.
ELBI—Liberian Broadcasting Co., Monrovia, Liberia.
FET—Radio Falange de Alicante, Sevilla 2, Alicante, Spain.
HBO—United Nations Radio, c/o Director of Information Service, European Office of U.N., Geneva, Switzerland.
HER5—Swiss Broadcasting Corporation, Neuengasse 30, Berne, Switzerland.
WRUL—World Wide Broadcasting Foundation, 133 Commonwealth Ave., Boston, Massachusetts, U.S.A.

SHORT Wave Notes for the July issue are due on June 9. For the August issue they are due on July 7. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, NSW.

NEW STATIONS

PAKISTAN: The short-wave services of Pakistan are rapidly extending as we now have Lahore operating as APL2 on 6.075 Mc. This station is reported to be on the air from noon till 3.30 am. English can be heard from this one on Mondays, Tuesdays and Wednesdays at 7.30 am.

MAURITIUS: Ken Boord, of the USA, reports that the Forest Side station in Mauritius has advised a listener that they are no longer transmitting in the 19-metre band, but have moved to 11.84 Mc, where they have an overseas program daily from 12.30 am to 3.30 am. Owing to interference on this channel Ken had not heard them at time of writing.

BULGARIA: For those listeners who have difficulty in identifying European stations except when they are broadcasting in English will be pleased to know that this language is used from Sofia on 7.67 Mc between 6 am and 6.30 am. They also have a new outlet on 7.255 Mc which can be heard at 7.15 am.

BRAZIL: For those who like the South Americans the following tips from the Universalite will help them to find the new Brazilian ZYP23, which is on 5.045 Mc. Station is known as Radio Quitandinha, is located in Petropolis and is on the air daily from 10.30 pm to midnight

NEW STATION LOGGINGS

Call	Kc.	Metres	Location	Time Heard
ZYP23	5045	59.49	Petropolis, Brazil	11.00 pm
APL2	6075	49.38	Lahore, Pakistan	11.00 pm
SAIGON	6170	48.62	Saigon, Indo-China	10.00 pm
SOFIA	7255	41.35	Sofia, Bulgaria	7.15 am
HRXW	8990	33.37	Comayaguela, Honduras	10.00 am
ATHENS	11720	25.60	Athens, Greece	5.30 am
V3USE	11840	25.34	Forest Side, Mauritius	1.00 am
YUF	15225	19.70	Belgrade, Yugoslavia	1.30 am
ROME	15425	19.46	Rome, Italy	6.30 pm

FLASHES FROM EVERYWHERE

PHILIPPINES: The following two ite were heard through Radio Australia c cerning DZH5 and DZH9. The Far E ern Broadcasting Co. Inc., of Man have increased their broadcasting ho and are now heard from 8.0 am till pm and 6.0 pm to 3.0 am. Their bro cast in 32 languages and dialects mention on their verification their r channel of DZH9 11.855 mc.

The Voice of the Catholic Philippi DZH5 on 9.69 mc has told listeners their verification that station power now 250 watts and they are very int ested in receiving reports which sho be mailed to Fr. Antonio Pinon, C DZST, University of Santo Ton Manila, Philippines.

INDO-CHINA: In a recent letter fr Mr. F. Smedley, of Landsborough, Q he tells us that Radio France-Asie pl to broadcast French lessons at 7.15 using a frequency of 15.15 mc. Th lessons are to commence early in J and the station wants prospective stude to write to them for written tests, to used in conjuncion with the broad sessions.

Providing reception of these sessi is favorable this would be an excell way to improve your French and be considerable use in following broad in that language. We imagine that 1 mc may not be the best choice of quency but time will tell.

ITALY: The same listener kindly gi us some further information regard transmissions from Radio Italiana. 29/4/51 the 11.81 mc outlet was drop in the Australian and Pacific session 15.425 mc adopted instead. The stati now in use during the session 6.15 to 7.38 pm are 21.56 mc, 17.803 mc, 1 mc, 15.425 mc, and 15.12 mc.

Jack Fox, of New Zealand, also m tions 7.11 mc as being used and menti another transmission, to North Ame being on the air from 10.0 am to 1 am on 9.67 mc, 11.905 mc and 15.12 I am afraid the Italians are making thi rather difficult to follow with t continued change of frequencies.

SWEDEN: A correspondent of the U versalite supplies some further inform tion regarding Radio Sweden in ans to a letter he wrote to them. They s that their two new 100 kw transmit are expected to be ready either late year or early in 1952. They stated t further information could be obtai from the Swedish Telegraph Board Ku Telegrafstyrelsen, Radiobyran, Brun bergs Torg 2, Stockholm. Radio Swe is anxious to obtain reports on t program "Sweden today" which is c piled and read by two American stude in Stockholm. In passing we might m tion that we have not heard the w known DX session for some time presume it is still on the air. The l channel used to be SDB2 on 10.87 m

AUSTRALIA: While listening one ni recently we were rather surprised hear a plain language broadcast fro naval shore station regarding some their aircraft. This broadcast was f the shore-based officer to a ship gave details of how many Sea Fu were available for the following and other pertinent information reg ing the day's flying.

How different this is to war-time w all such information is highly se and of course only transmitted in c Other interesting broadcasts emana in our own country are those betw aeroplane and aerodromes and we w recently intrigued to hear a message f one plane on which we had made a fl the previous day.

THE HAM BANDS WITH BILL MOORE

Radio amateurs will participate in the Commonwealth's Jubilee celebrations in October when the Wireless Institute of Australia will conduct the VK/ZL Jubilee DX contest.

GRANT of £250 has been made avail-
able from Jubilee funds for prizes
d publicity. Allan Fairhall MP, VK2KB,
esenting the case of the radio amateurs
the Jubilee Committee.
The contest will provide a unique op-
rtunity of publicising the Jubilee
roughout the world and the publicity
mpaign to present the Jubilee to the
rld's 125,000 radio amateurs will com-
nce shortly.
By means of stickers for QSL cards,
f sheets, certificates, and stories in
erseas journals and information passed
er the air, the news will be broadcast.
The contest will be run on behalf of
e Federal Executive of the WIA by the
W Division.
The Division's contest committee which
w becomes Federal Contest Committee
which Wal Ryan VK2TI is chairman is
eady working on the preliminary ar-
ngements. The NSW Divisional Council
re responsible for obtaining the grant.
1938 they ran a similar contest during
0th Anniversary Celebrations of NSW.

IS REGULATIONS

It is just two years since the new
gulations covering Amateur Radio in
e US were first proposed. They are
w officially gazetted, portion of them
came effective from March 1st, some
ll come into force on July 1st and the
mainder from January 1st, 1952. The
anges made are far reaching, but the
neral structure of them varies little
om those originally sponsored by the
C, although quite a number of them
ere strenuously opposed by the ARRL
d other bodies.
These were successful in obtaining only
me minor variations. The decision of
e Commission was by no means unani-
ous, and in a minority report two
embers, including Geo. E. Sterling,
3ZM, opposed many of the changes,
pecially those that cut facilities that
ould be available to old timers in the
ture.
With the introduction of a 20-word-
r-minute for the major class of licence,
e activity requirement before relicenc-
ng and the necessity to affirm that you
ave lost none of your ability to send
nd receive morse code through the
ears, makes it extremely difficult for
n old timer to keep his callsign. Per-
aps he has not touched a morse key
or 20 years, or just holds his licence
or sentimental reasons.
These new regulations are generally
directed so that the hobby in the future
will develop along lines considered by
he FCC to be in the best interest of
he nation in war and peace, not along
lines that rather followed technical de-
elopment and the desires of amateurs
ersonally.

ARRL OPPOSITION

It was this one point that was strenu-
usly opposed by the ARRL—it is regi-
mentation to some degree and is a
completely new departure in regulatory
matters in the US.
Section 12 of the regulations was the
portion in question. The actual wording
has been changed quite a deal but still
charges the FCC with the responsibility
of developing the hobby. As changed,
it now reads as follows:-
"Basis and Purpose: These rules and
regulations are designed to provide an
Amateur Radio Service having a funda-
mental purpose as expressed in the fol-
lowing principles: A. Recognition and
enhancement of the value of the amateur
service to the public as a voluntary non-
commercial communication service, par-
ticularly with respect to providing
emergency communications. B. Con-
tinuation and extension of the amateur's
proven ability to contribute to the ad-
vancement of the radio art. C. En-
couragement and improvement of the
amateur radio service through rules which
provide for advancing skills in both the
communication and technical phases of the
art. D. Expansion of the existing reservoir
within the amateur radio service of
trained operators, technicians and elec-
tronics experts. E. Continuation and ex-
tension of the amateurs unique ability to
enhance international goodwill."
The new licence structure is as follows
and qualifications are listed also:-
Amateur Extra: Morse 20 WPM, Theory
of radio telephony and telegraphy, general
regulations, and advanced radio theory.
Advanced class: Morse 13 WPM, Theory
of radio telephony and telegraphy, general
regulations.
General class: As for advanced class and
is available to members of the armed ser-
vices and applicants in isolated areas.
Technical class: Morse 5 WPM, Theory
of telegraphy and telephony and general
regulations.
Novice class: Morse 5 WPM and element-
ary theory and regulations.

NOVICE AND TECHNICAL

The most interesting classes from our
viewpoint are the Novice and Technical
classes with their 5 word per minute
morse requirement. The Novice class ex-
amination incorporates a very simple tech-
nical and regulations examination but is
is only available for one year. After that
period amateurs must sit for one of the
higher classes of licence. It is not renew-
able under any circumstances. Licensees
may use CW from 3,700 to 3,750 kc/s and
26,960 to 27,230 kc/s and voice and code
from 145 to 147 mc/s.
The Technical licence allows operation
above 220 mc/s and remains in force for
the normal period, 5 years, and is renew-
able. It is quite possible that we will see
the introduction of similar classes of
licences with similar examination require-
ments sponsored in other countries within
the next few years.
Band subdivisions have been changed
very little. The 3.5 MC telephony section
has been enlarged however and now covers
from 3,800 to 4,000 kc/s. NFM allocations
have been made permanent, and this type
of modulation is now permitted throughout
the entire 50 to 54 MC band.
Licence renewal conditions are however
changed considerably. Applicants for re-
newal must affirm that they have been
active on the air on either telephony or
CW for at least 2 hours in the last 3
months, or 5 hours in the last 12 months.
They also must affirm that they can send
and receive morse at a speed not less than
originally required for their class of
licence. ie, 5, 13 or 20 WPM.
It will be seen that the authorities have
set out to vary the regulations along
lines that will ensure, firstly, that the
morse ability of licencees will not de-
teriorate during the currency of the
licence, and, secondly, that they must
remain active or lose their licence and,
finally, much new blood will be intro-
duced into the hobby through the Novice
and Technical classes of licences.

WIA NEWS

THE ANNUAL MEETING of the NSW Division was held at Science House, Sydney, April 27th, 120 members were in attendance, including a considerable number of visitors. PAOASB came from furthest afield. The Hunter Branch was represented by the President, Lionel Swain, VK2CS, Secretary Varley Fitton, VK2SF, and members Bill Hall, VK2XT, and Harold White, VK2AHA.
The annual report of the President Jim Corbin, VK2YC, had been previously circulated to all members and was adopted.
The financial report was presented by Wal Nye, VK2XU.
Frank Joyen, VK2UX, was again appointed auditor for the Division. A number of members spoke in appreciation of the assistance rendered during the year by Frank in presenting advice on financial matters.
John Moyle, VK2JU, Federal Councillor, then presented his report on the proceedings of the 21st Annual Federal Convention held in Melbourne during Easter.
General business covered many subjects. One decision was in opposition to obtaining permanent Institute rooms. It was considered that the time was not suitable for such a venture.
It was also decided to endeavor to get members to make greater use of the library service available to them. The librarian Dick Dowe, VK2RP, reported on the service and arrangements will be made to speed up the distribution of periodicals.
Approximately half of the full members voted in the annual ballot for the council for the year 1951-1952. The retiring council were re-elected. They are Dave Duff, VK2EO, Wal Nye, VK2XU, John Moyle, VK2JU, Dave Evans, VK2AYE, Jim Corbin, VK2YC, Maurice Butler, VK2AAN and Vaughan Wilson, VK2VW.
The members of the council later elected Wal Nye as President and Dave Duff and John Moyle as Vice-Presidents.
In accordance with recommendation of the council and on the motion of Wal Nye, VK2XU, and seconded by John Moyle, VK2JU, the retiring President, Jim Corbin, VK2YC, was unanimously elected a life member of the NSW Division.

VALE WIRELESS RESERVE

As there has been no move to reform the prewar RAAF Wireless Reserve a decision was reached at the last Federal Convention to assist the normal recruiting activity of all arms of the services.
The record of the RAAF Wireless Reserve in the last war was an extremely meritorious one. Formed entirely of Radio Amateurs and supported by the Wireless Institute of Australia, members were called up for service at the outbreak of war.
Of the 196 amateurs so enlisted, 187 were commissioned during the duration. One member, Group Captain Vaughan Marshall, VK3UK, became the Director of Telecommunications and Radar in the RAAF.
In direct opposition to the RAAF's lack of activity, the RAF has announced the formation of the RAF Voluntary Radio Service and is calling for amateurs with morse experience at 20 WPM and ability to operate and do minor servicing to comunication receivers.
The object is to form an adequate and efficient reserve behind the Signals Branch of the RAF. Groups will be formed in various centres controlled by a Group Leader, who will be responsilbe for the training of members within his area.
Training will extend to the home as with our prewar wireless reserve, and radio receivers will be issued by the RAF. Occasionally attendance will be necessary at RAF reserve centres for discussions. Training bounties will be paid each year and members would be liable for call up for full time service if required in time of national emergency.
The Radio Society of Great Britain is organising a special Amateur Radio land travelling exhibition in the Festival of Britain celebrations.
The call sign of the station will be GB3FB and a special QSL card of distinctive design has been produced by the Festival authorities. The station will be

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There are staff cottages at many of the Northern Stations. Permanent employment, with all the advantages listed on the right, is assured suitable men. Vacancies exist now on certain stations and further vacancies will occur during the year when other officers retire on superannuation.

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erating from Manchester May 4th to Leeds June 23rd to July 15th, Birmingham August 4th to 26th, Nottingham ptember 15th to October 7th.
Various firms are supplying the equipent, a 100 watt station will be in operan and Australian stations are requested look out for GB8FB.
The International Amateur Radio Union ined four new member societies during 50, two societies were deleted from the t, and the total membership is now 42.
Of the two societies that retired, the st was the Newfoundland Society, ich was deleted from the list because the change of the political status of e country which is now part of Canada. ie Canadian section of the ARRL will w look after the interests of the VO's.
The second society was the CAV — echoslovak national society. The CAV oposed that matters relating to the ockholm Peace Appeal should be pubished in the IARU calender, but this as refused.
They also objected to the refusal of the RRL & RSGB to handle QSL cards aring political propaganda. The society ve these two reasons for their retirent from the Union.

X AND PERSONAL

HAROLD WHYTE, VK2AHA, and Jim Cowan, VK2ZC, struck a valuable ow for our hobby when they were interviewed over National Station 2NA ey presented a good case for amateur dio—it was valuable publicity.
The Cinesound film covering the acvity of amateurs at the WIA's North ast Convention was shown at many ntres and again provided useful pubity.
Another Amateur Radio expedition proded the DX of the month. Phil, M9AA, and his wife journeyed from eir home in Cuba to the French terriry of Guadeloupe and operated from ere under the callsigns FB7XA and B7XB. Using only 24 watts, they conted as many stations as possible durg their 14-day stay. All the leading K DX men added another country. perating both phone and CW they could e contacted in the afternoon or in the ornings the long way round. These peditions are getting rather popular ith trips to the Galapagos, Monaco, San arino and now Guadeloupe expect the ing will be able to find a few new spots.
North Coast zone officer Crieff Rettaek, VK2XO, is on the job early making rangements for next year's North Coast onvention. He announces he has made rangements with a tourist company to nduct a special tour of 7 days to runga next Easter. The coach will ave from Sydney and stop overnight Taree en route.
At last we have a Voice of America mateur radio broadcast at a reasonable our. You can hear this programme at 15 hrs EAST on 6, 9, 11 and 15 MC ands.
Two single side band stations have been oing good work. PK4DA and Orme ooper, VK2CP, have been heard in conct. The PK4 is putting out a beautiful gnal.
A recent press announcement stated at some of Sydney's taxi cabs will ortly be equipped with two-way radios. he RSGB recently pointed out that 0,000 taxis in the US are fitted with vo-way radios!

WHAT is probably the world's fastest photographic lens is claimed to have been developed by ne United States Army Signal orps. It has an aperture of f 0.6. t is mainly intended for use with notion-picture cameras for recording such low intensity phenomena s x-ray and cathode ray screens. t is generally considered that the argest aperture possible is f 0.5.

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24V	250V	100MA	£2 0 0
24V	250V	60MA	£1 10 0
24V	300V	250MA	£2 5 0
12V	210V	60MA	£2 10 0
12V	310V	50MA	£1 10 0
24V	360V	260MA	£3 10 0
12V	275V	60MA	£2 0 0
12V	550V	140MA	£5 0 0
24V	550V	140MA	£3 10 0
32V	275V	100MA	£3 10 0
32V	275V	60MA	£2 0 0

EXCELAIR RADIO

136 VICTORIA RD., MARRICKVILLE, N.S.W.

HOW USEFUL IS NOTHING?

(Continued from Page 13).

escopes, spectroscopes, television paratus and some head-lamps for tor cars are vacuum coated with ver or aluminium. Mirrors used this way are practically distor-nless. Maybe some day we will ve ordinary household mirrors de in this way which will not ke us appear as if we had a bad ngover.

AVEL IN VACUUM

Now we find Dr. Irving Langmuir, great physicist of America, en-aging long tubes exhausted of air which airtight vehicles are mag-tically suspended, travelling rough this space at 5000 miles an ur. Some day, maybe, but not w, thanks.

Of course these high vacua are t easy to obtain. No one yet has hausted the air *completely* from y vessel. They are all trying hard do so mainly to see what happens. is doubtful, however, if anything re will happen than happens now, close have the scientists got to a rfect vacuum.

The diffusion pump developed by e aforementioned Dr. Langmuir is e best type of pump so far. It is pable of exhausting so much air m a vessel that the residue would ve to be increased over 10 trillion nes to restore normal atmospheric essure. That's getting pretty close nothingness.

IR PUMPS

There are several types of vacuum mps, such as the jet pump, the echanical pump and the diffusion pe.

The jet pump acts something like atomiser. Air or steam at high essure is driven across the mouth the vessel to be exhausted. This cks out the air from the container. ne of these pumps can reduce the to about 1-15th of atmospheric essure. These are usually used here high vacua are not necessary.

The mechanical pump makes use an eccentric rotor which sweeps st the opening of the vessel to be hausted. This draws the air from e vessel, which is then sealed off hile the rotor, continuing its revo-tion, pushes the air out a small nt. The next time round, the ssel is opened and the rotor sucks re air out and so on.

The rotor works at high speed and is pump sucks much more air out an the jet type.

The diffusion pump is the real ing so far. Its construction is a tle difficult to describe. It makes e of a boiler in which mercury or is heated. This builds up to a gh pressure and rushes past the ening in the vessel to be exhausted. is high-pressure heavy vapors cks out the air very efficiently.

The jets are multiplied inside the por chamber so that pressure is ilt up to a very great extent. The por, on reaching the sides of the por chamber, condenses back to liquid and falls back into the boiling container where it is used over again.

In theory this pump is capable of producing a perfect vacuum, but so far has not done so. What it has done, however, is near enough not to matter much.

Science, therefore, by producing "nothing" has produced something which is of inestimable value and promises more as new applications are found.

AUDIO DISTORTION MEASUREMENTS

(Continued from Page 59)

tested at each of the test frequencies.

To do this, the bridge input cable is connected directly to the output terminals of the test oscillator. With the toggle switch S1 in the "adjust" position and the test oscillator and frequency selector switch set at the proper test frequency, the output of the test oscillator and the gain control (R2) are adjusted to give full scale deflection of the distortion meter.

Then, when S1 is thrown to the "Read" position, the meter reading should drop to a very low value. To minimise the reading, the null resistor (R1) and the test oscillator frequency must be varied simultaneously.

If the null bridge is functioning properly, the adjusted null at some frequency near the desired test frequency will be quite sharp and the meter reading will be very nearly zero.

If an incomplete null is obtained, the bridge components are faulty or the test oscillator has some harmonic output which is being indicated on the meter. The nature of this residual reading can be readily determined by the use of the search oscillator.

With the distortion meter operating as above in the "Read" position, the search oscillator is connected to the audio transformer input leads and enough search signal is injected to about double the residual reading on the meter.

The frequency range of the test signal and its harmonics is then explored by varying the frequency dial of the search oscillator slowly. If there is a large beat fluctuation of the meter pointer at the fundamental frequency and little at its multiples, the residual reading is caused by imperfect bridge balance.

If the converse is true, the harmonic content of the test oscillator is to blame for the incomplete null. The harmonic output of the test oscillator should be carefully recorded so that it can be discounted when actual amplifier tests are being made.

DISTORTION ANALYSIS

In using the bridge to analyse the distortion introduced by an amplifier, the procedure followed is the same as that used above for determining the distortion content of the oscillator except that the amplifier is introduced between the test oscillator and the bridge, as shown in Fig. 3.

The bridge input leads are connected directly across the speaker voice coil or other normal amplifier load. The gain of the amplifier is set to the value at which it is desired to determine the distortion.

The null reading is then obtained as above and, expressed as a percentage of the full scale reading of the meter minus the residual reading, is the total distortion percentage introduced by the amplifier. The harmonic components may then be individually identified by the use of the search oscillator.

Each beat noted indicates a component of that frequency (read from the search oscillator) and relative magnitude present in the output of the amplifier.

FROM THE SERVICEMAN WHO TELLS

(Continued from Page 35)

when there was probably still a normal span of life to be expected from it. On the other hand it was quite useless in its present form, so there was nothing to lose by trying.

Accordingly I removed as much solder as possible from the top cap, hoping that the lead wire would be revealed, but found that I could just see the end and there was not much chance of getting at it to clean it. The top cap itself seemed firmly cemented to the top of the envelope and I was not keen on the idea of forcing it for fear of fracturing the glass.

I thought of trying to soften the cement, so enlarged the hole in the top cap and sat the valve upright in a socket. Into the top of the cap I introduced a few drops of methylated spirit, and repeated the dose every quarter of an hour or so as I proceeded with routine jobs around the shop. Although I have heard of such jobs being left overnight, only about two hours were necessary in this case, by which time the cement was quite soft and the cap was removed without risk.

I was now able to clean the lead wire carefully and with the aid of some flux get it properly tinned. This wire is not copper as is often imagined, but a special alloy designed to have the same temperature coefficient of expansion as glass, and it needs to be very carefully cleaned when it is to be soldered.

Since the existing lead was too short to come through the top of the cap, I twisted a short length of tinned copper wire around it and soldered this joint before fitting the cap. When the cap was fitted it was easy to solder to the tinned copper wire and be sure the joint was a good one. Finally the cap itself was cemented in place with some cellulose adhesive.

OFF THE RECORD — NEWS & REVIEWS

The problem of sound distribution from the loud speaker is one which has received plenty of discussion, but probably less practical attention than other links in the reproducing chain. Probably this is because the average man finds more difficulty in doing something about the speaker than, for instance, the pick-up.

By JOHN MOYLE

A GREAT deal of theory has been expounded concerning pick-ups and corresponding practical improvements have been made particularly in the last few years. The need for light weight, good compliance, and better styli has found expression in plenty of designs.

It's true, also, that better speaker units have been built, and are being built all the time. But notice that word "units.." A loud speaker isn't much good on its own. It must be properly coupled to the air in the room before its good or bad qualities can be assessed.

In other words, suitable baffling and attention to room acoustics are part and parcel of the speaker system.

There are probably two main things to consider when using a speaker. The first is the mounting and baffling of the unit. The second concerns the manner in which the wave-front produced by the loud speaker develops throughout the room, and the general distribution of the sound from the unit itself.

For after all, baffling mainly concerns the lower register below say 150 cycles. It isn't related intimately to frequencies higher than this—in fact it has very little effect on them.

It is this distribution of hig frequencies throughout the ro which has received comparativ little attention except in elabor units mostly beyond the pocket the average man.

Now without getting too dee involved in technicalities, it is p sible to consider this problem in g eral terms without pulling too ma doubtful analogies or making sweeping assumptions.

It is generally true that the hig frequencies tend to be radiated fr over a more restricted angle th the low frequencies. The extre upper range may be propagated a particularly narrow "cone" if y like, which can be fully appreciat only when the listener is direc within its boundaries.

CORNER PLACING

Generally speaking, if the speak cabinet is placed in a corner of t room remote from the listener, m of the audience space will be co ered fairly well by the majority speaker range.

Exceptions to this statement wou be the extreme upper register whi many speakers do not radiate w any efficiency.

In theatre work, for instan where good general coverage needed, a number of smallish hor are grouped together in a "cell" that each is aimed to cover a giv portion of the auditorium. Othe wise those sitting at the sides wou hear very little of the upper regist at all, and would have difficulty following dialogue.

The same principle applies to lesser degree to an ordinary roo particularly if things must be arran ed so that the listeners are spre out over a wide area.

DEFLECTING VANES

For that reason, a few deflecti vanes in front of the speaker are oft helpful in spraying the top regist more evenly throughout the roo These may be only a few inch deep and because speakers are oft mounted at about head height, ne be directional in the horizontal pla only—in other words the vanes wou be vertical. They should "point" t ward the cone centre, may be fl should have a hard, enamelled metal surface, and be mounted qui close to the cone.

Two such vanes, dividing the di tribution into three sections, w usually be sufficient.

To avoid reflections of high fr quencies—and they will bounce any hard surface quite easily—

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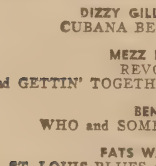

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t planes should face the speaker. at's another reason why the ner of a room is often the best t for the speaker.

If the walls opposite the speaker e broken up by furniture, fireplace, curtains, reflected waves will also broken up, and cleaner reproction can be expected. This would more important at high levels, which most of these matters are re likely to apply.

Some of the very best domestic eakers which employ multiple nes fed through dividing networks tually follow the movie theatre actice by having in-built cellular rns to obtain even higher note stribution. If we don't go as far this, we can often improve things good deal by going part way on the es I have indicated. Many of our aders have added much pleasure their listening by experiments of is type.

There is more which could be said this subject, but I want now pass on to another relevant mat- which is tied up with the char- teristics of the sound source.

INGLE POINT SOURCE

The major difference between ori- inal and reproduced sound is that e first originates from a three imensional source, while the second mes from a single point source.

An orchestra, for instance, occupies e whole width of a concert plat- rm, and also extends considerably depth, and possibly in height. A tring quartette or a piano and solo- st create sound which, although riginating from a smaller area than at from an orchestra, is never- eless propagated from an appreci- ble area.

But when these are reproduced rom a single speaker, we get a "hole n the wall" effect, for which no mount of speaker placing in the ormal way can even partially com- ensate.

It has been said by a number of vriters, many of whom apparently hink they invented the idea, that he impression is as though the per- ormers were on one side of a par- ition, and the listeners on the other, vith a more or less large hole in etween.

While I have my private doubts s to the complete legitimacy of the nalogy, it does serve to illustrate fundamental objection to the single peaker technique.

The alternative is to provide some nethod of increasing the aperture f the sound source so that it is ropagated from an area larger than at of a 12-inch cone.

TEREOSCOPIC SOUND

A suggestion which has been resur- ected recently overseas, is to face he loudspeaker into a suitably shap- d and dimensioned bowl so that the isteners hear the sound reflected rom the bowl.

The principle isn't by any means ew. It has come very much to he forefront in connection with nicro-wave transmitters, which, be- ause of their very short wavelengths, roduce signals capable of being radi- ted from a reasonably sized bowl or section of a bowl with good efficiency.

The shape of the radio "bowls" are made to give propagation in a beam, the boundaries of which can be suitably controlled. In our case, we would need a bowl designed to give satisfactory dispersal throughout the room.

The point is, of course, would it work? By the aid of simple diagrams which make excellent doodling practice, I think it can be shown that listeners would still receive the sound from a single spot on the reflector. If they were at the focal point of the bowl, they would get the lot, but it would have been narrowed to a point about the same size as that of the speaker itself.

REFLECTORS

If, instead of a large bowl, a number of shallower bowls were used, each one of the smaller bowls would radiate sound to the listener, who would then undoubtedly hear it from as many points as there were small bowls.

But, wait a minute — wouldn't we do better to use a number of speakers instead of bowls, apart from the fact that we'd avoid structural alterations to the wall in these hard times? I'll say we would.

If you ever get the chance to hear four 12-inch speakers operating "in line" over about eight feet, you'll appreciate just what they can do in opening out those wretched holes in the wall.

Remember, too, that because each speaker is asked to handle only one-quarter of the total power, you can get bass reproduction four times the power of a single speaker if your amplifier will give that much.

I once heard a battery of speakers — some dozens of them, mounted in a huge baffle in a small theatre. The effect was spatial, all right — in fact, it was an eye-opener in many ways.

One big advantage of using several speakers in the home, spread out over about 10 feet, is that the impact of the wide sound source can be greatly emphasised by a process of frequency selection.

MULTIPLE SPEAKERS

Three speakers, a bass speaker at the left, middle range in the centre, and top range at the right, can so split up the sound that the source can easily be "spotted" according to frequency.

This was the principle in the "stereoscopic" reproduction system about which I wrote many articles before the war. Admittedly, things don't always split themselves up from left to right according to frequency, but that isn't the important point.

One could get the effect of a piano playing at the left, and a soprano singing from the right. A few high notes would tend to stray across the room in such a case, but not so as you'd notice. On orchestral work in a big room, the effect was really impressive. The extra dimensional effect just couldn't be mistaken.

The original system used simple acoustic and electrical filtering to get the frequency division, and we had lots of arguments about phase distortion and so on. But many of my readers who heard that system at my home still refer to it as the best they remember. Four speakers were used — two "woofers" in a large loading horn, a 42-ounce magnet middle range speaker, and a tweeter. We could do much better today, and it wouldn't take much encouragement for me to try!

At any rate, I'm firmly convinced that the multiple speaker idea is streets ahead of such fantastic ideas as sitting in a chair imagining an orchestra to be on the other side of a hole in the wall. I don't want to waste my energies imagining when I hear music. If I am interested in widening the source of sound, I want it to impress itself on me so that I don't have to imagine anything.

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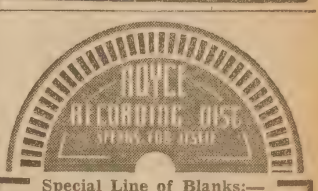

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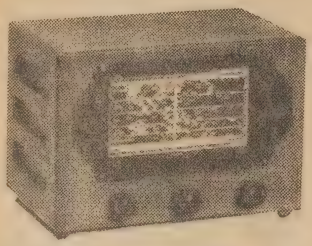

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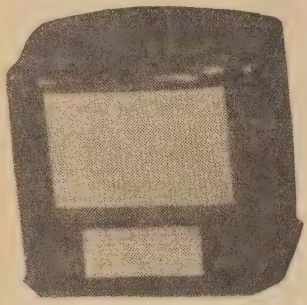

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A COURSE IN TELEVISION

(Continued from Page 45)

ross the deflection coils, the value the resistor being selected to give lequate damping without absorbing ore power from the amplifier than n be tolerated.

Effective damping in the line cir-its is more difficult and it usually volves the use of a diode damping be. An elementary circuit arrange-ent is shown in figure 4.

Here the circuit is arranged so at the plate side of the trans-rmer is positive during the forward ace. The diode therefore con-ucts during this period but the nstants in the cathode circuit are rranged so that its shunting effect no more severe than necessary.

The flyback pulse drives the plate omentarily negative and the diode nposes no restriction on the circuit this during the first half-cycle of e potential high frequency oscilla-on.

The moment the current tends to verse by reason of the "ringing" fect, the diode damping becomes vident and the power stored in e "tuned circuit" is rapidly dis-pated.

The diode may be a power rec-fier type of tube operating in the rimary circuit or it may be a low npedance metal rectifier connected ross the low impedance secondary.

More elaborate schemes feed the ctified output from the diode amper back into the plate circuit the line output amplifier to effect desired change in the linearity its output. This is just another xample of the measure adopted by esigners to obtain a required end sult.

YOUR ANSWER, TOM

(Continued from Page 47).

As the value of the current is ntinually varying, it becomes ecessary to specify when the read-g was taken and that's where root-ean-square and certain other terms me in. At first consideration the ost obvious thing may be to meas-re the maximum or peak value of e current. However, the diffi-lty here is that the peak value does t give a true idea of the ability the current to do a job of work.

From a practical point of view, e RMS value of the current is the alue which dissipates the same mount of power in a circuit as the me value direct current. For ex-mple, a radiator would generate qual amounts of heat if operated om 240 volts RMS AC or 240 volts C.

Almost invariably when we speak AC voltages we refer to the RMS alue. However, it is very handy note the relationship between MS and the peak values, particu-rly when dealing with AC power pplies. The RMS value is .707 of e peak value and the peak value 1.414 times the RMS value.

DIAGNOSIS BY ELECTRIC MD's

(Continued from Page 11)

finger on the overhanging part and up she comes without tremor.

Any pilot will tell you that to open your mouth at 200 mph in an open plane would be very stupid and if you try to hold out your hand from an aeroplane cockpit the air at high speeds is so hard that it knocks it back as if it had been hit by a brick.

I once saw air escaping from a pressure chamber at about 5000lb per square inch. Hammers and spanners and half bricks bounced on the stream exactly like the ping-pong balls which dance on a thin water jet at a shooting-gallery.

So you must think of this factor of speed. Engineers always do. When gas has to travel fast in a pipe they calculate the bends as if they were dealing with treacle and not air. Air in inlet pipes compresses, gets hot and bounces about like a lot of springs.

FLOATING METAL

During the war, and at the height of London's bombing, I was engaged on toying with explosives in an area round which burning houses enabled the reading of a newspaper in the middle of the night to be comfort-ably practicable. So you will understand that the anti-aircraft defences were of some interest to me.

A friend came along with the suggestion that if we could fill small cylinders a few feet long and a few inches in diameter with hydrogen, releasing them in millions, they would prove definitely unpleasant to enemy pilots.

He did not realise, of course, that to achieve such an object the aluminium would have to be so thin that it could never be used in practice.

Yet one can understand that without a little arithmetic he could easily go wrong, for the gasbag of the original Zeppelin was constructed entirely from sheets of aluminium. The volume of gas contained in this way was far greater in proportion to its weight than could ever be arranged with small containers.

No aluminium could be made sufficiently thin to render the use of hydrogen-filled walking sticks of any purpose although I should mention that metals can be so thin that light is often transmissable. The colors and interference with light waves which result are surprisingly beautiful.

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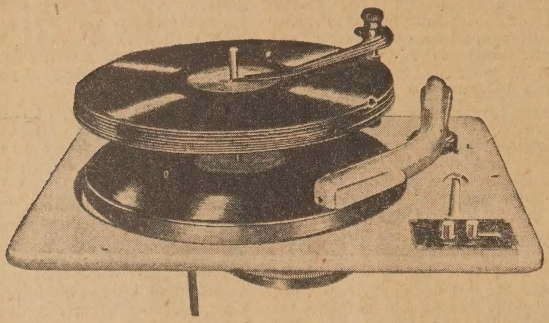

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ANSWERS TO CORRESPONDENTS

R.M. Kellerberrin, WA) sends in the ... a crystal set with one-valve ... which he would like to see ... He is a schoolboy at the ... but mentions that he would ... do experimental radio work later ...

... Many thanks for your letter and the ... It is very gratifying to note that ... efforts are an inspiration to some ... the younger members of the com... It is from these younger mem... that the radio engineers of the ... will be chosen. We must point ... however, that to attain any worth... position it is necessary to study ... for many years. In the meantime ... present series of "Learn While You ..." articles should be of great assist... to you as they make it possible ... absorb a great deal of information ... a practical angle. Your circuit is ... no means new but some of our ... who happen to have the valve ... be interested so we will file it for ... future use at a later date. By ... way, there is at least one error in ... circuit which we would need to cor... before publication.

J.B. (Bunbury, WA) sends in a query ... the "Answer Tom" page and also ... a query regarding a commercial ... playing unit.

A. Your query will be answered in an ... issue but we regret that we cannot ... in the matter of the lightweight ... head. The only suggestion we ... make is that you write to the manu...

P.P.T. (Singapore, Malaya) forwards a ... which is suggested as being suit... for the Reader Built It page.

A. We have scrutinised your circuit ... and associated description with ... mention of results obtained, P.P.T., ... unless you have made some error ... where, we fail to see how you could ... such phenomenal results from ... in which detection but no valve ... takes place. There is a pos... that you have been misled in ... way. Your circuit additions can ... cause only deterioration of per... from the usual standard cir... of such a simple set. Are you sure ... have not confused valve types ... arranged the wiring of the valve ... using so that it is functioning ... rudimentary triode?

A.G.L. (Elimbah, NSW) sends in a cir... for the "Reader Built It" page.

A. Thanks for the circuit, A.G.L., which ... file for future consideration. ...ally, there is nothing very out of ... ordinary in the arrangement, but not...standing, it may be of interest to ... Many thanks also for the kind ...hes.

J.W. (Fairfield, Vic.) sends in a ques... for the "Answer Tom" page.

A. Many thanks for your contribution ...ich has been filed and will be con...ered as soon as possible.

F.P. (Cook, Trans. Line, South Aus...lia) sends 12 months' subscription and ...kes some comment on articles which ...lies. He also details some of the ...iculties of reception in remote areas ... suggests that we may be able to ... aside a section for country listeners.

A. Many thanks for your subscription, ...P., and the details have been for...rded to the appropriate department. ...o glad to have your comments on the ...gazine, as well as those on conditions ... your locality. It is not likely that ... will be able to devote a section to ...ntry problems, as you suggest, but we ... always mindful of the problems of ...se areas, and try to devote a fair ...ta of our articles to battery sets and ...icles designed to help our country ...ders. Your suggestion for an article ...opening a service shop has been noted ... we have in mind to do something ...g these lines in the near future.

J.C. (Lismore, NSW) is seeking infor...tion on the cost, availability of con...uctional details and the source of ... other information on the Geiger-...eller counter.

A. Well, P.C., we ourselves have no such information in our files on this matter nor are we aware of the availability of plans for general home-construction of such items other than what may have appeared in overseas magazines, principally of American origin. On the matter of cost and availability of the finished product, we can only suggest that you communicate with some of the large electronic manufacturers, such as A.W.A., 47 York St., Sydney, or Philips Electrical Industries, 69-73 Clarence St., Sydney. With regard to general description and, possibly, constructional plans, we suggest that you visit a public library and go through some of the issues of particular American magazines with emphasis on those published over the last year or so.

C.B. (Blackheath, NSW) writes to thank us for a previous reply through the 1/- query service.

A. We were very pleased that we were able to help and trust that the photographic copies you ordered will come to hand soon.

H.E.C. (Priory, via St. Helens, Tas.) writes in appreciation of Radio and Hobbies. He finds the Serviceman Who Tells series of articles very valuable in connection with his work which deals with servicing of equipment and cinematograph operating.

A. Your kind remarks are very much appreciated and we trust that you will find as much interest in future articles. Your suggestion has been noted.

H.H. (Coogee, NSW) is very keen to see some articles published on the construction of tape recorders, and encloses a very comprehensive list of the specifications and requirements of such a device.

A. Many thanks for your suggestion and the specifications, H.H., and we hope to describe some kind of recorder as soon as we can iron out a few of the problems of designing one for home construction. In the meantime we are filing your letter and will keep the specifications in mind.

G.P. (Malvern, Vic.) wants to know if a person of fourteen and a half years can hold a Radio Amateur's Ticket, and what books are available on the subject.

A. We are afraid you will have to wait a while, G.P., as the minimum age at present is 18 years, but there is no reason why you cannot take some active interest in this very interesting hobby. We suggest that you concentrate on the receiving side for the present, as there is much to be learnt and plenty of scope for experimenting in the building of suitable communication receivers. With a satisfactory receiver operating you will be in a position to observe the procedures adopted on the air, and all this experience will stand you in good stead when the time comes for you to take your exam.

In addition to the regular magazines, such as Radio and Hobbies, we suggest that you obtain a copy of our own Short-wave Handbook, and also of the Radio Amateurs' Handbook, published by the American Radio Relay League. These will give you a good start, and you can add to them later as required. Glad you like the Learn While You Build It, and this will be continued for several months at least.

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes, and cutouts will be supplied if available for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, "Radio & Hobbies," Box 2728C GPO, Sydney.

7-BAND TEST OSCILLATOR

(Continued from Page 69)

Most constructors will be obliged to use a standard wafer switch, however, and arrange the resistors to give the least possible parallel capacitance. The complete stepped attenuator assembly should be enclosed in a shielded compartment.

The modulator follows the familiar Hartley circuit and uses a push-pull speaker transformer. As usual, the constructor must be prepared to experiment with the circuit to obtain the most suitable frequency and waveform. The circuit values were the ones which worked out best in our case but they vary with every individual transformer.

Switching allows the audio valve to function either as a modulator or as an amplifier for an external modulating tone.

Two controls, brought out to miniature knobs on the front panel allow a variation in tone and modulation depth, while the audio signal is available, if required, from a jack.

The power supply is conventional and calls for no special comment. Any small filter choke will suffice. A couple of solenoid chokes in the power leads assist in RF filtering.

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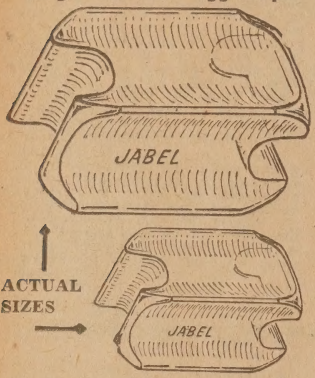

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FOR SALE: Cigarette Lighters, storm type, brass and black metal with two spare flints. English make, 4/9 ea. Money refunded if not satisfied. **Rowe, Box 742, G.P.O., Sydney.**

FOR SALE: Communication Type Receiver. National Type N.C.100. Also U.S. Navy Type. T.B.W. Transmitter, modified for ham use, 813 output. Excellent gear. Offers. **J. L. Anderson, 101 Hudson Street, Hurstville, N.S.W.**

FOR SALE: Hallicrafter Receiver, Model S38. 5 Tube Superhet, 4 Band, No. 1 .55-1.6, No. 2 1.7-5, No. 3 5-14, No. 4 13.5-32, Megacycles. Band spread vernier, standby control, noise limiter, AM & SW, SW pitch, controls. Speaker & phone commutator. New condition. **G. Rundell, 28 Barnard Grove, North Kew. WA9364.**

FOR SALE (owing to injuries received in truck accident): 1 Model S.G.1 Palec Signal Generator, brand new, 1 Model T.S.T. University Supertester, 1 Model U.S.O. Universal Speaker, both used not more than a dozen times. What offer? All inquiries answered. **H. M. Grace, 30 Hamilton Rd., New Norfolk, Tas.**

ONE-VALVE Speaker Set with Short-wave Coil. Best offer. **Mr. R. Byrne, 3 Sorrett Ave., Malvern, S.E.4.**

SELL: Power Supply, 1000v. 300mA Bandswitching Transmitter, 3.5/28 £18. VFO, 7/14mcs., £7/10/-. Presele 14/28mcs., £7/10/-. Prop. Motor, £4. Selsyns, £2. AC/DC Multimeter, Broadband Tuners, £2. Parabulars, **Colyer, Box 1884, Sydney.** [illegible] JX

SELL: 9 Valve Short-wave R[illegible] offer. **20 Gladstone Pde., JM1769.**

SELL: Garrard Motor Turntable **Phone Kimber, M2921, 9 to 5.**

SELL: Phillips' Dynamic Microphon new, with desk stand and flex, £6/ postage paid. **Whitehouse, Fox St., gett, N.S.W.**

SELL: Garrard AC/DC, 120/240v Gr Motor, together with Tecnico Crystal Pickup in polished table cab As new, £11. **J. Kowald, Clara St., Mu Bridge.**

SELL: Bc453 Cnverted 12v Car R complete, £25. AR8 Rec., AT5 Power Supply, 12v. Offers. **18 Mo Street, Merrylands West.**

WANTED: Coil Boxes with or wit coils from H.R.O. or Kingsley C munication Receivers. **D. Sanderson Annie St., Torwood, Brisbane.**

HELPING TO CHOOSE YOUR CAMER

(Continued from Page 77)

error, and a few models compensate for this by means of masks located behind the ground glass, and coupled to the focusing mechanism. Even without this feature the parallax is seldom a serious problem at the minimum distance for which the camera is designed.

Lens sizes are either f4.5 or f3.5 and between-the-lens shutters are invariably used. The range of speeds is similar to that quoted for the folding cameras. The picture size seems to have almost been standardised at 2¼in square, giving 12 pictures on 120 or 620 size film.

The advantages of this type are the large viewing image and the ease of focusing as in the case of the reflex, plus a bright image on the screen irrespective of the diaphram setting. Since most models provide a larger lens for viewing than for taking, particularly when the taking lens is only f4.5, they have a further advantage over the true reflex.

On the other hand, they do not possess the versatility of the true reflex, especially in regard to the interchange of lenses, nor does the shutter provide such a wide range of speeds.

A word of warning may not be out of place here. There are many cameras built along the same general lines as the twin reflex, but which do not possess any coupling between the taking and viewing lens. Thus they lose the main advantage of the scheme and become little better than any camera with a large viewfinder as one has to fall back on estimation or measurement to provide focusing [illegible]

[illegible] question of negative size is one which should be carefully c sidered before a camera is purcha

Briefly, the position is this. the negative becomes smaller camera becomes more compact it is possible to provide higher sp shutters and larger aperture len Against this is the fact that sm negatives must be enlarged to them justice, and there is introdu the problem of emulsion grain minute defects in the negative wh would probably pass unnoticed i contact print.

A larger camera has limitati placed on the size of lens and maximum speed of the shutter, is able to produce acceptable prints by contact. However, t will seldom be as large as those p duced from a smaller camera enlarger and, in any case, the de available from a good lens is seld shown to advantage without enlar ment.

However, if contact prints only contemplated the popular 2¼in 3¼in would probably be regarded a minimum, although some may c sider the 2¼in square size accepta but it would seem unwise to go bel this. Where enlargements are pr tical this size is also a good cho being a nice compromise betw low running cost and a good ne tive area to keep grain problems, & to a minimum. Almost as good is 2¼in by 1 5-8in (127), although roll of this film costs nearly as mu as a roll of 120 and only yields ei pictures instead of 12.

What is the best camera? As Irishman said when he saw the ka garoo, "There ain't no sich anim There is only one best suited to yo needs and pocket and we hope t article will help you choose it.